

Importance of the Periodic Technical Inspection and the Inspection Interval for Road Safety

Final Report

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1. Introduction

The long-term objective of the EU strategy “Vision Zero in road transport” is to have no fatalities and no serious injuries by 2050. The interim target for 2030, according to which the number of road fatalities and serious injuries is to be reduced by 50% compared with 2020, is very likely to be missed. The German Federal Government’s road safety programme has set the transport-policy objective of reducing the number of road fatalities by 40% compared with 2020 on the path towards Vision Zero. In Germany, too, this target is very likely to be missed by a considerable margin. In the Road Safety Pact in Germany, not only policymakers but also the relevant stakeholders have committed themselves to contributing to Vision Zero through their own measures. In addition to the field of road-user behaviour, the fields of infrastructure and safe vehicle technology also contribute to achieving the Vision Zero targets. In view of almost 20,000 road deaths across Europe in 2025, an overall decline that is too slow, and an increase in road fatalities in Germany by 44 compared with 2024 to 2,814, decisive measures to improve technical road safety are essential.

As one such targeted measure, on 24 April 2025 the European Commission presented a proposal to revise the Roadworthiness Package. The planned directives on the periodic technical inspection of motor vehicles and on the technical roadside inspection of commercial vehicles are intended both to significantly reduce the number of fatal or serious-injury accidents and to reduce road-traffic emissions.

This study is intended to provide answers as to the contribution that the periodic technical inspection of motor vehicles can make, and already does make, to achieving the targets for reducing fatalities and serious injuries.

1.1 Study contents

In July 2025, Dresden University of Applied Sciences, as project lead and project implementer, together with AFUS Forschungsgesellschaft mbH as project administrator, submitted an offer to prepare a

“Study on the effects of a possible dynamic adjustment of the inspection intervals for motor vehicles of categories M1 and N1 on improving road safety in Germany”.

The study was to include the following investigations:

1. Development of the number of vehicle registrations depending on vehicle age.
2. Relationship between the age of the vehicle and the age of the vehicle owner.
3. Development of the number of accidents involving fatalities and injuries depending on the number of vehicle registrations and the age of the vehicles.

4. Relationship between the number of vehicle accidents and the annual distance travelled depending on vehicle age.
5. Relationship between the number of persons killed and injured in accidents and the number of vehicle registrations depending on vehicle age.
6. Determination of the proportion of accidents in which major defects are identified in the course of accident analyses, differentiated into the following categories: (a) not relevant to the accident; (b) causal, contributory and/or accident-promoting; (c) based on a targeted full survey of data collected in the field by third parties/accident analysts according to the specifications of the study directors from at least 5,000 current accident analyses involving vehicles of categories M1 and N1 (optionally L1) since 2020, including data from earlier years if necessary.
7. Relationship between the number of accident-relevant defects and vehicle age.
8. Relationship between the number of accident-relevant defects and the time elapsed since the last periodic technical inspection.
9. Determination of technical defects and unauthorised technical modifications to vehicles immediately before maintenance and repair prompted by the periodic technical inspection, depending on vehicle age, on the basis of a targeted sample conducted by third parties/experts according to the study directors' specifications from at least 10,000 current inspections per vehicle category in 2025.
10. Relationship between expenditure on maintenance and repair and vehicle age.

On 24 July 2025, TÜV-Verband accepted the offer.

1.2 Reasons for the investigations

The Impact Assessment Report [Q08] accompanies two legislative proposals by the European Commission:

- Proposal to amend the following directives: Directive 2014/45/EU on periodic technical inspections of vehicles (PTI), and Directive 2014/47/EU on technical roadside inspections of commercial vehicles (RSI).
- Proposal to revise registration documents and vehicle-register data concerning Directive 1999/37/EC (VRD).

On 24 April 2025, the European Commission presented a proposal to amend Directive 2014/45/EU on the periodic technical inspection of motor vehicles and trailers. The aim of the measures provided for therein is to improve road safety while at the same time reducing excessive air-pollutant and noise emissions from motor vehicles of categories M1 and N1. The proposal is based on the assumption that safety-relevant defects as well as problems or tampering affecting exhaust aftertreatment systems increase as vehicle age increases. In

the Commission's view, this leads not only to a higher accident risk due to unsafe vehicles but also to additional avoidable pollutant emissions.

A central element of the proposal is the introduction of an annual periodic technical inspection for motor vehicles of categories M1 and N1 that are more than ten years old — a rule already applied in more than half of the EU Member States. In this way, the Commission aims to reduce the number of road accidents and accident victims by about one percent. This is justified, among other things, by the fact that older vehicles are more prone to breakdowns and are involved in accidents at an above-average rate. Although technical defects account for only a small proportion of accident causes, the Commission considers annual inspections suitable for nevertheless making a tangible difference.

In addition, the Commission assumes that, during the emissions test as part of the periodic technical inspection, a large proportion of vehicles with defective exhaust aftertreatment and some of the tampered systems can be detected. Early detection and rectification of such defects could prevent a significant share of excessive NO_x, particulate and other air-pollutant emissions.

1.3 Main criticisms of the existing system and intended measures

The European Commission sees deficiencies in particular in the current emissions tests, in the consideration of modern vehicle technologies, and in the digitalisation of administrative and documentation processes. In the Commission's view, the existing test procedures are only of limited suitability for reliably detecting modern exhaust aftertreatment systems as well as tampered or defective emissions-relevant components. In addition, driver assistance systems, software functions and other safety- or emissions-relevant electronic systems have so far been included only to a limited extent in technical inspection. A further weakness identified is the differing national procedures for vehicle registration, documentation and data exchange, which make cross-border information exchange and the fight against fraud more difficult in particular.

The main intended measures are:

- Readjustment of test procedures: introduction of modern test standards for electric vehicles, ADAS and emissions-relevant systems; measurement of ultrafine particles and NO_x during the periodic technical inspection.
- Annual inspection of older vehicles: for passenger cars and light commercial vehicles from the age of 10 years.
- Digitalisation: electronic vehicle registrations and inspection certificates; central cross-border data platform.
- Protection against fraud: storage of odometer readings to combat odometer fraud.

- Expected benefit: between 2026 and 2050, around 7,000 lives are to be saved and 65,000 serious injuries prevented.

Outdated test procedures, the increasing spread of modern vehicle technologies, and existing deficits in digital documentation and networking are identified as central challenges. The objective of the proposed measures is to modernise technical vehicle inspection, strengthen checks on older vehicles and advance the digitalisation of processes. This is intended to improve road safety, reduce emissions and make the implementation and administration of technical inspection more efficient.

1.4 PTI – Country comparison in Europe

The country comparison illustrates that the design of periodic technical inspection within the European Union varies considerably because the common legal framework defines only minimum standards. For example, Member States specify different testing technologies, testing equipment and depths of inspection according to regional circumstances. Sixteen Member States also require annual technical inspections for older passenger cars, whereas eleven Member States — including Germany — predominantly apply biennial inspection intervals (see Table 1). The different rules express the minimum harmonisation enshrined in Directive 2014/45/EU, in recognition and implementation of the principles of subsidiarity and proportionality established by the Treaty of Amsterdam, which leave Member States scope for efficient rules and requirements at national, regional and local level. In this way, different and efficient approaches to technical inspection are developing in Europe, shaped among other things by the age structure of vehicle fleets, national experience with road safety and historically evolved inspection systems, thereby contributing to innovation in the European Union and, taking account of regional specificities, to achieving the European Union's objectives regarding road safety and environmental compatibility of road transport.

The country comparison, specifically regarding inspection intervals for older passenger cars, serves primarily to place the current European debate on possible changes to inspection intervals in context and to assess different regulatory approaches. It does not constitute an assessment of the effectiveness of individual national inspection systems and is not itself part of the ongoing European legislative process. Rather, it shows the range of inspection frequencies currently practised in Europe and thus provides the context for the amendments to Directive 2014/45/EU proposed by the European Commission.

Table 1: Introduction – Country comparison – annual PTI in Europe

Category	Member States	Number
Annual PTI for older passenger cars	Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, Greece, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Austria, Poland, Slovakia, Spain	16
No annual PTI for older passenger cars	Germany, Finland, France, Italy, Malta, Portugal, Romania, Sweden, Slovenia, Hungary, Cyprus	11
EU Member States total		27

*Detailed table in Annex 1

2 Review of the international state of research

This chapter presents the international state of research on the topic. In addition to sources of different origins, various focal points are explained; these are referred to below as clusters. The main focus was on identifying the benefit of PTI in general and on a further examination of annual inspections of older vehicles in categories M1 and N1.

A large number of studies have already demonstrated the benefit of PTI, showing that the introduction of periodic vehicle inspection was accompanied by a significant reduction in the accident rate, fatalities and injuries. The majority of EU Member States already conduct an annual PTI for vehicles of categories M1 and N1 that are more than 10 years old. A number of studies on motor vehicles of categories M1 and N1 have also already been published which examine the effectiveness of an annual PTI for older vehicles.

2.1 Diversity of the source research

Publishers of the publications

- European institutions / politics: European Commission → supranational authority.
- National ministries / authorities: BMV (Federal Ministry of Transport) → federal ministry; KBA (Federal Motor Transport Authority) → national authority; BASt (Federal Highway Research Institute).
- Testing and inspection organisations (technical services, PTI/emissions testing): DEKRA; TÜV; FSD (central body under the Road Traffic Act).
- Associations / clubs: ADAC; VDI (Association of German Engineers); TÜV Verband e.V.; CITA (International Motor Vehicle Inspection Committee).
- Research institutions: TNO (Netherlands Organisation for Applied Scientific Research) → public research institution.
- Business / industry organisations / other: DAT (Deutsche Automobil Treuhand GmbH) → industry company, data and information service provider; IERC (Institute for Economic Research and Consulting) → private research institute; scientific publications by individual authors.

Countries and thematic orientation of the publishers

Table 2: International state of research – diversity of source research by publishers and countries

Publisher	Country / level	Category / type	Remark
European Commission	Europe (EU)	Supranational authority	Legislation, regulation
CITA (International Motor Vehicle Inspection Committee)	International	Umbrella association	Association of inspection organisations
BMV (Federal Ministry of Transport)	Germany	Federal ministry	Formerly BMVBW
KBA (Federal Motor Transport Authority)	Germany	Federal authority	Registrations, statistics
ADAC	Germany	Automobile club / interest association	Europe's largest automobile club
FSD (Fahrzeugsystemdaten GmbH)	Germany	Central body	Entrusted under the Road Traffic Act
VDI (Association of German Engineers)	Germany	Engineering and professional association	Professional society
DAT (Deutsche Automobil Treuhand GmbH) and IERC	Germany	Industry / data provider	Vehicle and residual-value data
DEKRA	Germany	Testing and inspection organisation	Internationally active, based in Stuttgart
TÜV	Germany	Testing and inspection organisation	Internationally active
TÜV Verband e.V.	Germany	Association of TÜV organisations	Umbrella association
TNO	Netherlands	Public research institution	Applied research, including vehicle technology
Author(s)	Worldwide	Scientific articles	Publications in specialist journals

2.2 Historical development of PTI

The following section considers the starting point of periodic technical inspection (PTI). It first places in chronological context the proposals for amending the inspection under the “2006 re-conception of regular technical inspection”, the introduction of common road-safety rules under “Directive 2014/45/EU”, and the European Commission’s proposal to amend this directive.

2.2.1 Early findings from insurance and accident statistics

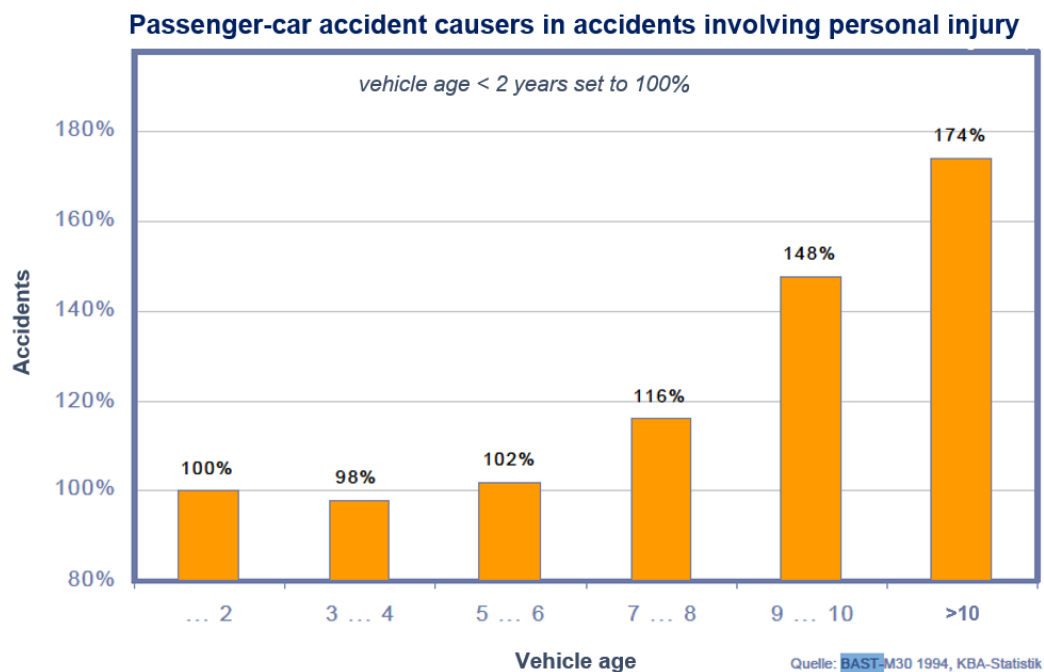
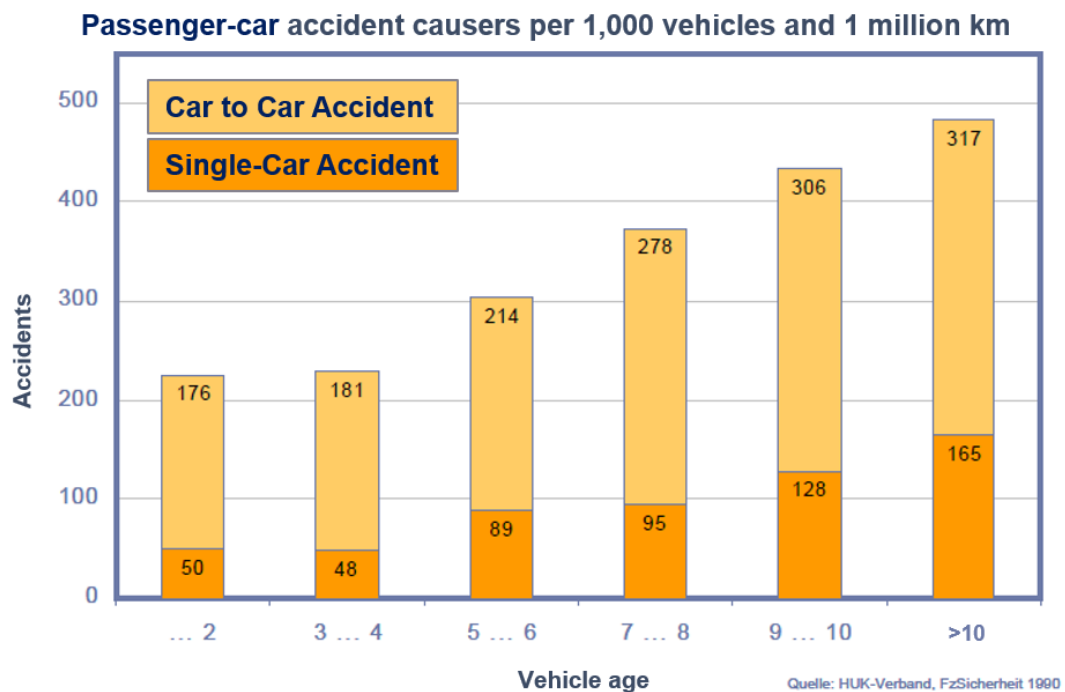
Table 3: International state of research – findings from insurance and accident statistics (1990 and 1994)

1990–1994	Early findings – accident statistics	Key statements (brief summary)
HUK-Verband, Vehicle Safety, 1990 [Q37]	HUK-Verband, Vehicle Safety	Older passenger cars (>8 years), in relation to distance travelled, cause twice as many accidents as younger passenger cars; in single-vehicle passenger-car accidents, the rate rises to three times the value for younger passenger cars.
BAST-M30/KBA, 1994 [Q38]	BAST-M30 1994, KBA statistics	Road accidents involving personal injury: older passenger cars have significantly more accidents per 1,000 registered vehicles than younger passenger cars.

The body of research shows that the line of argument in favour of shorter inspection intervals had already been discussed in earlier analyses in Germany (see Table 3). An early reference is an investigation by insurers (GDV), cited as HUK-Verband, Vehicle Safety, 1990 [Q37]. It describes a clear relationship between vehicle age and accident burden: in relation to the distance travelled, older passenger cars — especially those more than 8 years old — cause significantly more accidents than younger vehicles. This effect is presented as particularly pronounced in single-vehicle passenger-car accidents, where the accident rate for older vehicles is three times higher than for younger vehicles.

In addition, reference is made to evaluations of official accident statistics (BAST-M30, KBA statistics, 1994 [Q38]). These highlight in particular that, for road accidents involving personal injury, older passenger cars — relative to the number of registered vehicles — are involved in accidents involving personal injury more frequently than younger passenger cars (see Figure 1). The age effect is therefore supported not only for general accident numbers but explicitly also in the segment of accidents involving personal injury.

Figure 1: International state of research – passenger-car accident causers [Q03 based on data from Q37, Q38]



2.2.2 Discussion in the early 2000s

Table 4: International state of research – initial situation and national discussion on annual PTI from 2002 to 2006

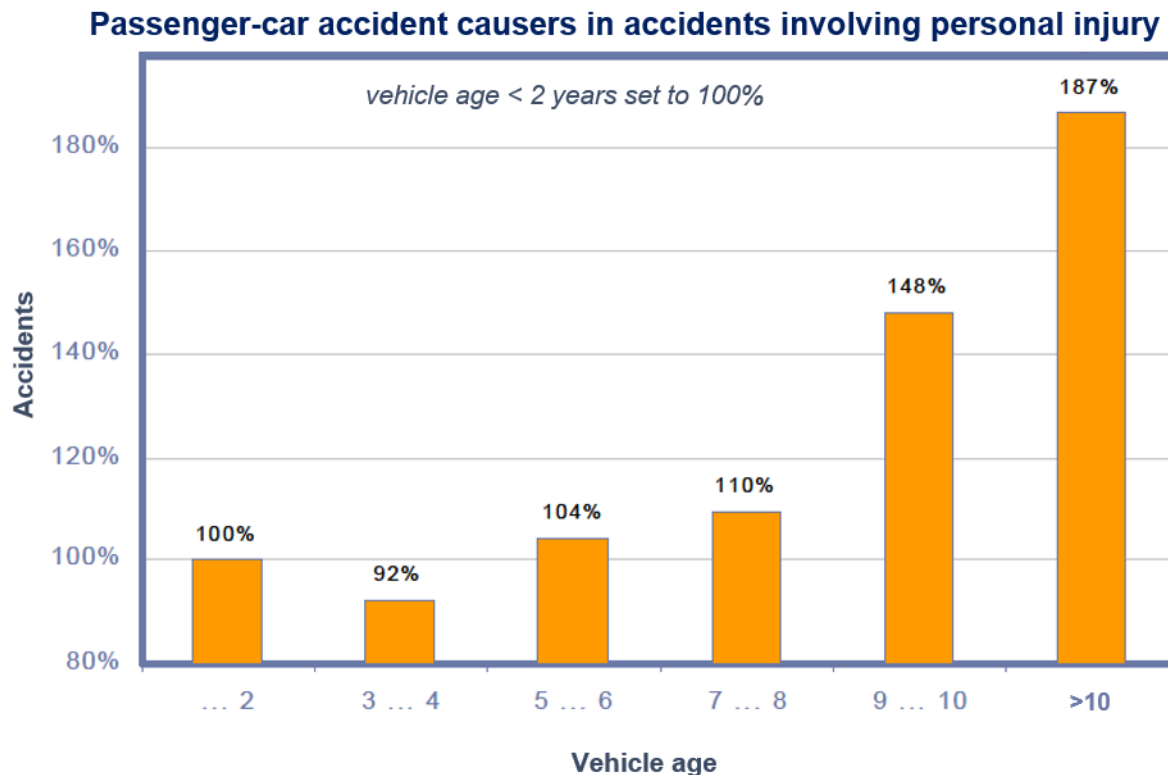
Source/year	Title	Key statements (brief summary)
BMVBW, 2002 [Q03]	“Review of inspection intervals”	Call for annual PTI from 8 years; high defect rates in older vehicles (every second passenger car >8 years has technical defects); 20,000–75,000 accidents annually avoidable through shorter inspection intervals; around 42% of accidents caused by technical defects avoidable.
ADAC, 2012 [Q36]	“ADAC position on annual PTI”	No evidence that older vehicles occur more frequently in accident occurrence; annual PTI without safety benefit, but with a high social and economic burden.
FSD, 2012 [Q01]	“Critical appraisal of the ADAC study”	ADAC analysis incomplete: actual PTI use and mileage not taken into account; correction shows increasing accident involvement over the PTI period; every second vehicle is presented early for PTI.

As early as the beginning of the 2000s, Germany had an intensive debate about the effectiveness and the time intervals of the periodic technical inspection (HU/PTI) (see Table 4). One basis was the document published in 2002 by the Federal Ministry of Transport, Building and Housing (BMVBW) [Q03], prepared by the working group “§29/§47a StVZO”. The purpose of this investigation was to review the existing inspection intervals on the basis of statistical data and accident analyses.

The document argued clearly in favour of shortening PTI intervals, particularly for older vehicles. The focus was on the proposal to introduce an annual periodic technical inspection for passenger cars from a vehicle age of eight years. The argument was based on extensive numerical analyses: it was shown that older vehicles are disproportionately often involved in accidents and that technical defects play a significant role. According to the document,

passenger cars more than eight years old had twice as many technical defects as an accident cause as younger vehicles, and every second passenger car over eight years old had at least one relevant technical defect. Passenger cars aged 10 years and above were involved in 70–80% more accidents involving personal injury than vehicles aged 4–8 years.

Figure 2: International state of research – passenger-car accident causers in fatal accidents [Q03]



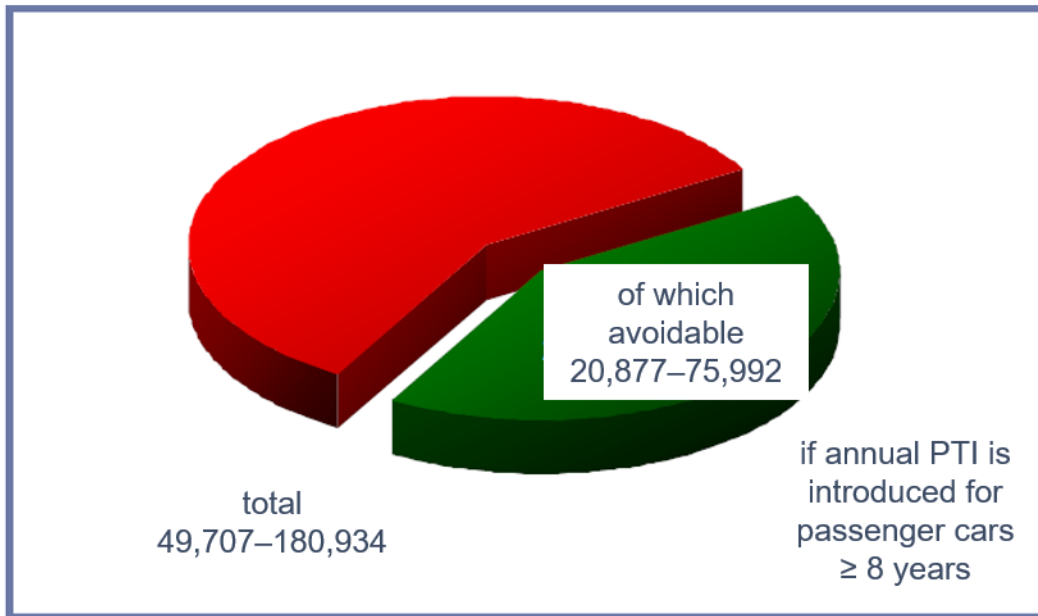
It was also shown that older passenger cars are less frequently maintained professionally. About one quarter of accident vehicles more than eight years old were repaired by the owners themselves, often without proper professional inspection. In addition, older passenger cars were more frequently subject to technically unauthorised modifications and were operated in an overall poorer condition. According to the working group, the accident risk increased significantly as the time since the last PTI increased.

The quantitative calculations in this study showed considerable potential for improving road safety through annual inspection. According to the calculations, shortening PTI intervals to one year for passenger cars aged eight years and above could avoid 42% of accidents caused by technical defects. This corresponds to around 20,000 to 75,000 accidents per year, as well as 42 to 154 fatalities and up to 11,700 injuries. The macroeconomic benefit was put at EUR 295 million to EUR 1.07 billion, while the additional PTI costs would be only around EUR 230 million. Ecological aspects were also emphasised, since older passenger

cars and light commercial vehicles (N1) with high defect rates have negative effects on the environment and air quality due to oil leaks and defective exhaust-gas cleaning systems.

Figure 3: International state of research – accidents involving passenger cars caused by technical defects [Q03]

Accidents involving passenger cars caused by technical defects per year



However, the data basis dated from the 1990s, so the working group already pointed out at that time that the figures might be outdated. Nevertheless, the paper was a central starting point for the later discussions within the framework of the “2006 re-conception of regular technical inspection”.

2.2.3 Controversy over shortening PTI intervals

In 2010, FSD [Q41] presented an empirical validation of the existing requirements for periodic technical inspection (PTI). The analysis is based on an exceptionally broad database of more than 46 million PTI data records and around 200,000 in-depth technical inspections from the period 2008 to 2010. The aim of the investigation was to compare the actual technical condition of vehicles in real road traffic with the results of the periodic technical inspection.

The results show a clear difference between the technical condition of vehicles before the periodic technical inspection and their condition at the time of the PTI. In particular, a pronounced effect of so-called PTI preparation becomes visible. Many vehicles are deliberately repaired immediately before the PTI, meaning that the defect rates identified during the inspection systematically underestimate the average technical condition of the vehicles during regular operation. This is illustrated by the defect rates for category M1

vehicles over several PTI cycles. Around four weeks before the PTI, approximately 27% of vehicles already have defects at the first PTI, but this share falls to only 4% at the time of the PTI. As vehicle age increases, this effect becomes significantly stronger: at the third PTI, defect rates before the PTI are already 54%, and at the fifth PTI as high as 72%, while the official PTI results continue to show significantly lower values (12% and 17%, respectively).

The study concludes that the real technical condition of the vehicle fleet in traffic is significantly worse than the results of the periodic technical inspection alone would suggest. The main reason for this is the temporally concentrated repair work carried out before the PTI, which, while leading to formal roadworthiness in the short term, does not allow reliable conclusions to be drawn about the condition of vehicles over the entire inspection interval.

ADAC [Q36, Q04] took a clear opposing position to the considerations at the time. In its 2012 position paper [Q36] — based on analyses later continued until 2023 [Q04] — the automobile club argued against the introduction of an annual periodic technical inspection. ADAC commissioned Verkehrsunfallforschung Dresden GmbH to conduct the investigations. The study concludes that technical defects play a role in less than one percent of all fatal accidents. In 2023, only seven of 2,830 road fatalities were attributable to technical defects in passenger cars, and no statistical relationship with PTI frequency could be demonstrated. No accident-relevant safety deficits could be demonstrated for older vehicles. The overrepresentation of older vehicles in road accidents was attributed to an above-average number of young drivers. In summary, the GIDAS accident database did not confirm that older vehicles occur more frequently in accident occurrence, nor that vehicles with increasing time since the last PTI more frequently appear as accident causers.

Furthermore, it was emphasised that shortening inspection intervals would lead to high administrative and financial expenditure without any measurable safety gain being expected. ADAC also pointed to social unfairness, since older vehicles are often used by lower-income persons with lower mileage. An annual PTI would therefore place a disproportionate burden on these population groups.

However, the conclusion derived from the investigation results — namely that shortening PTI intervals generally cannot be expected to provide any additional benefit for road safety — must be critically assessed. The published results first show that no statistical relationship between the time since the last PTI and accident involvement could be demonstrated within the data examined. It cannot be directly inferred from this, however, that more frequent technical inspections generally have no influence on road safety. Rather, on the basis of the data available in 2012, no robust evidence could be provided that shortening the PTI interval would increase road safety.

Figure 4: International state of research – accident numbers by time since the last PTI for passenger cars younger/older than 7 years [Q36]

Time since the last PTI on the day of the accident, in months Passenger-car age: 0–7 years vs. >7 years

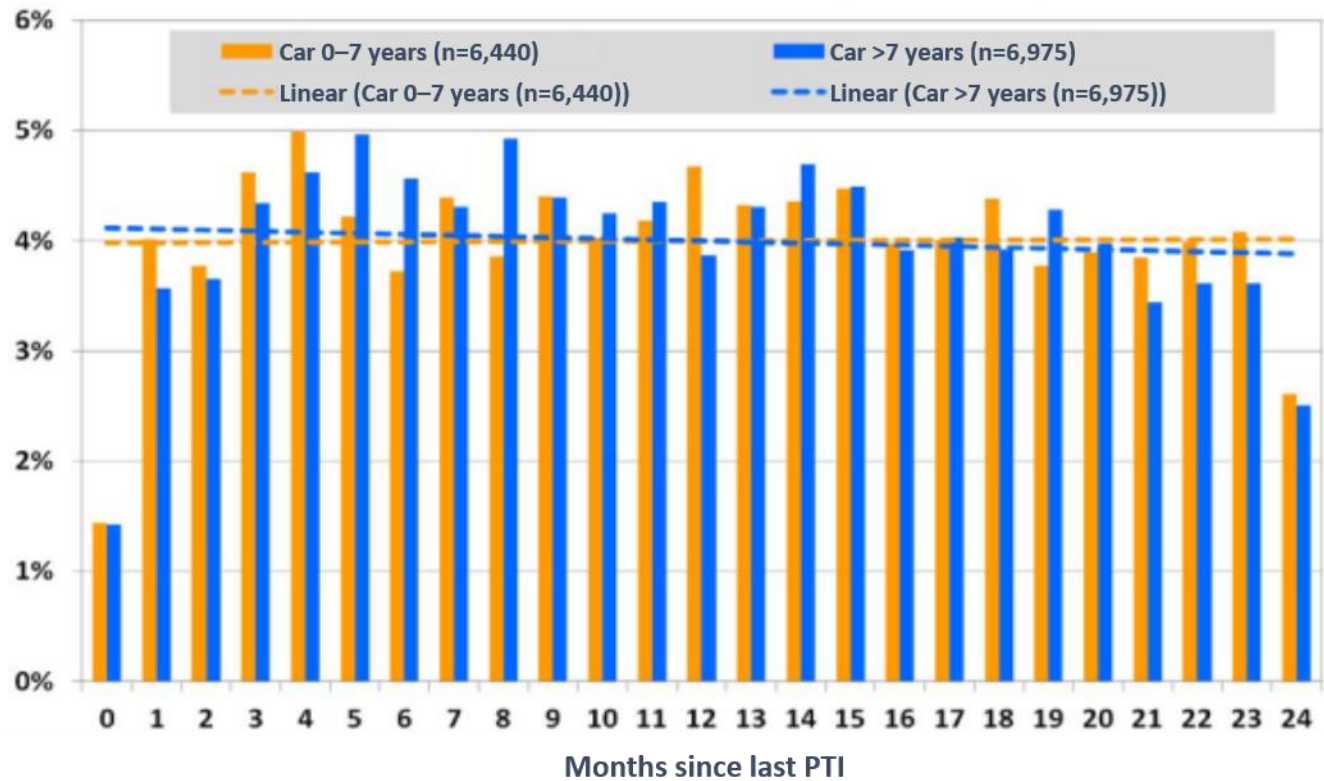
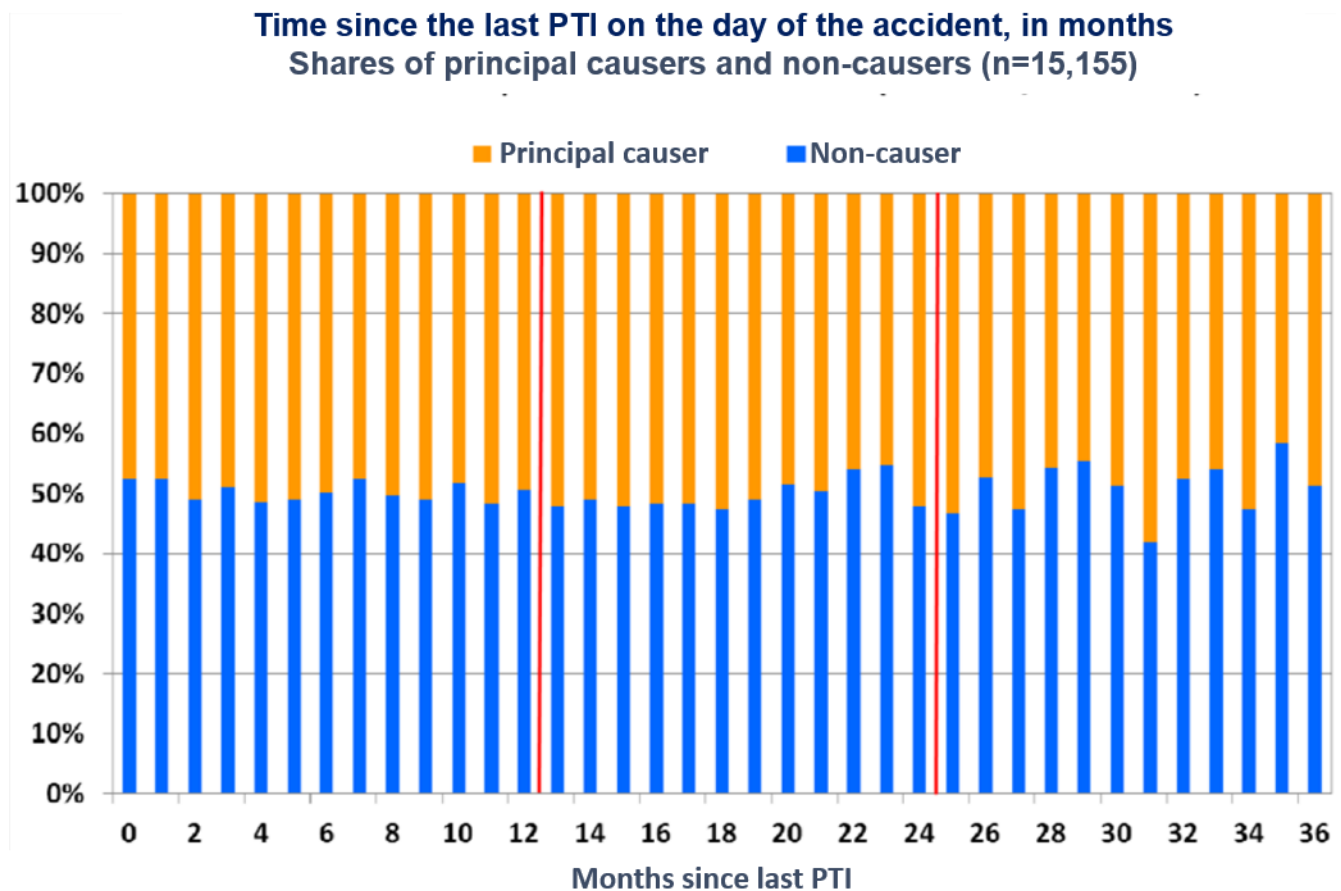


Figure 5: International state of research – accident numbers by time since the last PTI for passenger cars (principal causers / non-causers) [Q36]

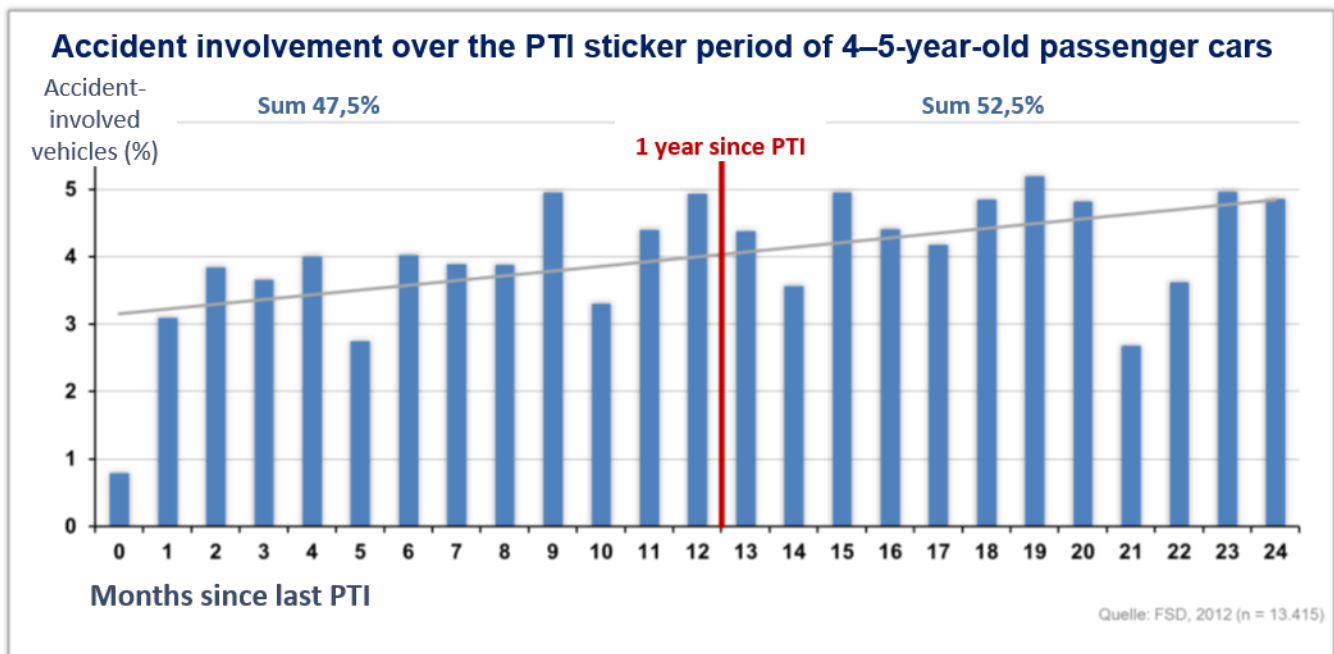


FSD's later methodological criticism is directed in particular at the assumptions underlying the evaluations regarding vehicle use, mileage and the actual utilisation of PTI sticker validity periods. The discussion thus illustrates that the interpretation of the results and the conclusions drawn from them are not undisputed in the professional community. A further difficulty is that the underlying original study by Verkehrsunfallforschung Dresden GmbH is not publicly available and could not be inspected despite research. The assessment is therefore based on published statements, presentations and secondary sources, so the traceability of the methodological approach and of individual assumptions is possible only to a limited extent.

In 2012, FSD published a critical appraisal of the study commissioned by ADAC [Q01]. It criticised the fact that key influencing variables had not been taken into account in the analysis, such as the actual utilisation of the PTI sticker validity period, the development of annual mileage over the vehicle life cycle, and technical progress in both vehicle safety and inspection technology.

FSD concluded that, after correcting for these influencing factors, increasing accident involvement over the validity period of the PTI sticker can be identified. Every second passenger car (all age groups) is presented early for PTI, and a degressive decline in annual mileage per year of vehicle age is apparent. Significant differences in the use of older vehicles were also observed, especially for those with high mileage or low maintenance frequency.

Figure 6: International state of research – correction of the distribution of accident numbers depending on time since the last PTI (months), based on the ADAC study, by accounting for real PTI sticker validity-period use and annual mileage (FSD, 2012 [Q01])



FSD's conclusion states that periodic technical inspection of motor vehicles contributes significantly to maintaining the safety level of vehicles. However, the investigations did not take into account the influence of driver age or the deregistration of vehicles.

2.2.4 Benefit-cost assessment of shortened inspection intervals

In 2012, BAST presented an economic assessment of different scenarios for adjusting the inspection intervals of periodic technical inspection [Q39]. The basis is a benefit-cost analysis in which the expected saved accident costs are compared with the additional costs resulting from more frequent periodic technical inspections. The central assessment criterion is the benefit-cost ratio. A benefit-cost ratio greater than 1 means that the monetised benefit exceeds the costs incurred, whereas a ratio below 1 indicates a measure that is not economically advantageous.

The results show that the benefit-cost ratio is below 1 for the vast majority of the scenarios considered. This means that, under realistic assumptions regarding accident avoidance,

inspection costs and defect reduction, the additional costs of shortening inspection intervals for older vehicles are generally higher than the expected overall economic benefit.

Exceptions arise only in two highly idealised scenarios. These assume that an annual periodic technical inspection for older vehicles — beginning at a vehicle age of seven or eleven years respectively — can realise the maximum benefit in the form of saved accident costs. At the same time, it is assumed that this annual inspection is carried out only every second year as a full periodic technical inspection, while in the intervening years only a so-called “small PTI” is performed, which involves significantly lower costs. Under these specific assumptions, a benefit-cost ratio greater than 1 can be achieved mathematically.

Table 5: International state of research – scenarios for adjusting inspection intervals and their economic assessment

Scenario	Description	Maximum scenario (incl. unreported cases)	Working scenario (incl. unreported cases)
EU (4–2–1ff)	Corresponds to EU proposal: first inspection after 4 years, then every 2 years, annually from year 10	0.84	0.67
B (3–2–2–1ff)	Annual inspection from 7 years	0.80	0.67
C	From 7 years every 2 years: “small PTI” (80% of the PTI price)	1.63	0.84
D	From 11 years every 2 years: “small PTI”	3.02	0.89

Overall, the study illustrates that a blanket shortening of inspection intervals for older vehicles cannot be clearly justified from an economic perspective when realistic assumptions are applied. The benefit-cost analysis thus provides an important counterweight to purely safety-oriented arguments and underlines the need to consider inspection intervals, inspection scope and actual mechanisms of effect in a differentiated manner.

2.2.5 International developments and harmonisation after 2014

Table 6: International state of research – international development after adoption of EU Directive 2014/45/EU

Source/year	Title	Key statements (brief summary)
-------------	-------	--------------------------------

IERC, 2016 [Q34]	“Impact Study – PTI Turkey”	Introduction of PTI in 2008 reduced accident costs by around 9%; decline in accident-related vehicle defects; PTI reduces the number of road fatalities by 40%.
European Parliament, 2020 [Q10]	“Implementation of the Roadworthiness Package”	EU directives led to a significant safety improvement; lack of maintenance is causal in around 4% of accidents; increasing defect rate with higher vehicle age / mileage.
IERC, 2024 [Q33]	“Evaluating Efficacy of PTI in Türkiye”	Positive correlation between PTI and road safety; 890,000 accidents calculated as avoided between 2008 and 2022; economic benefit confirmed.
CITA [Q13]	“Relationship between vehicle defects checked in roadworthiness inspections and those identified in collision analyses”	Analysis of worldwide research on the introduction of PTI: reduction in accident rate, fatalities and injuries through the introduction of PTI.

With the adoption of Directive 2014/45/EU, a harmonized European framework for periodic technical inspection (PTI) was established for the first time (Table 6). Together with the accompanying Directives 2014/46/EU (vehicle registration documents) and 2014/47/EU (roadside inspections of commercial vehicles), its objective was to introduce uniform minimum requirements for inspection intervals, testing equipment, inspector qualifications, and the mutual recognition of inspection results among Member States.

According to the European Parliament's 2020 evaluation [Q10], this harmonization has made a significant contribution to improving road safety across the European Union. The evaluation analyzed 450 documents from 27 EU Member States. While the Member States largely implemented the directives, differences remained in their practical application. The implementation assessment found that inadequate vehicle maintenance and technical defects continue to account for approximately 4% of all road crashes, and for up to 5% of crashes involving goods transport vehicles.

The report emphasized that the frequency of PTIs plays a crucial role in ensuring the roadworthiness and operational safety of vehicles throughout their entire service life. It also concluded that crash risk increases with both vehicle age and accumulated mileage.

In an international analysis, CITA [Q13] found clear evidence that the introduction of periodic technical inspections has been associated with a significant reduction in crash rates, fatalities, and injuries (Table 7).

Table 7: International evidence on the safety benefits of introducing periodic technical inspections (PTI) (CITA, [Q13])

Study	Percentage reduction in collision rate
European Commission (2019)	18% (in fatalities in Spain for mopeds)
Schulz and Scheler (2019)	40% (in collision rate in Costa Rica)
Schulz and Scheler (2016)	15% (in fatalities in Turkey)
Keall & Newstead (2013), New Zealand	8% (during the transition from an annual to a semi-annual frequency of technical inspections)
Rune Elvik (2001), Norway	5-10% (with an increase in the frequency of technical inspections by 100%)
Asander (1992), Sweden	16% (in collision rate with serious injury)
NHTSA (1989), USA	10% (in collision rate)
White (1986), New Zealand	10-15% (in collision rate)
Rompe & Seul (1985)	50% (in collision rate, from US studies)
Berg et al. (1984), Sweden	14% (in police reported collisions) 15% (in accident rate with serious injury)
Schroer and Peyton (1979), USA	9.1% (in accident rate, after technical inspection, compared to uninspected vehicles) 21% (in accident rate, after periodic technical inspection, compared to uninspected vehicles) 5.3% (in accident rate for inspected vehicles compared to accident rates of vehicles before the inspection)
Little (1971), USA	5% (in death rates)

2.2.6 Empirical experience from Turkey

The introduction of periodic technical inspection (PTI) in Turkey in 2008 is frequently cited as an international example of the possible impact of regular technical vehicle inspections. The 2016 impact study published by the Institute for Economic Research & Consulting [Q34] concludes that the introduction of the TÜV Türk system was associated with an improvement in road safety and a reduction in the macroeconomic costs of accidents. Referring to earlier investigations, the study reports that accident costs declined after the introduction of PTI and that positive effects on road safety resulted. In this context, a reduction in road fatalities of up to 40% is often mentioned. However, this figure is based on secondary sources and is not independently empirically verified in the study.

A more recent study by the same institute from 2024 [Q33] extends the observation period to the years 1990 to 2022 and analyses the relationship between PTI and road-safety indicators using statistical time-series models. This study also concludes that the introduction of PTI correlates with a positive development in road safety. For the period 2008 to 2022, the model-based assessment identifies a reduction of 5,033 road fatalities in total, or an average of around 335 road fatalities per year.

The evidential value of these results must nevertheless be assessed in a differentiated manner. Both studies are based on aggregated national time-series data and do not provide direct evidence at vehicle level. Moreover, the 2024 study is a further development of the analytical approach already used in 2016. The results therefore provide indications of a positive relationship between PTI and road safety, but they do not constitute unequivocal causal proof of the effect of shortened or more frequent inspection intervals. The Turkish experience can therefore be classified as supplementary international evidence; however, its transferability to the European regulatory context is limited.

2.2.7 Current developments and proposals by the European Commission

Table 8: International state of research – European Commission proposals and current developments

Source / context	Key points
European Commission Impact Assessment Report 2025 [Q08]	Preparation of a possible revision of Directive 2014/45/EU; four alternative PTI concepts differing in frequency, technological scope and age differentiation of vehicles.
Measure PM6	In three of the four concepts (PO1b, PO2, PO3), annual inspection of older vehicles from an age of ten years is envisaged.
Expected safety effects	Between 2026 and 2050, around 7,000 lives could be saved and around 65,000 serious injuries prevented.
Cost dimension	Technical upgrading of inspection centres alone would require around EUR 1.1 billion by 2050; additional costs for workshops and end users would also arise.
Additional PTIs	The number of additional PTIs across Europe is estimated to increase from 41 million in 2026 to 47 million in 2050.
Estimated safety gain	Reduction in accidents of around one to two percent; environmental benefits are also expected, especially regarding vehicles with defective exhaust aftertreatment systems.

In a written hearing of the Schleswig-Holstein State Parliament in 2025 [Q31], TÜV-Verband e.V. supported the EU initiative. In its assessment, the introduction of annual inspection intervals for older vehicles has the potential to significantly improve both road safety and environmental compatibility.

The association refers to current investigations according to which more than 25% of vehicles aged ten to eleven years show major or dangerous defects at the periodic technical inspection, even though most owners specifically prepare their vehicles for the PTI. Accident analyses also show that around 5 to 10% of all accidents are associated with safety-relevant technical defects.

From both an ethical and macroeconomic perspective, targeted technical monitoring of older vehicles is considered necessary. In view of a rising average vehicle age of more than 13 years in Europe and more than 10 years in Germany, an adjustment of inspection intervals to the technical reality of the vehicle fleet is considered appropriate.

By contrast, an analysis from Spain (Magaz, 2025) [Q19] shows that annual PTI already applies there from a vehicle age of ten years. Rejection rates increase markedly with increasing vehicle age, while the current inspection frequency (4-2-2-2-1-1-...) is regarded as sufficient. This suggests that annual technical inspection of older vehicles in practice leads to higher defect detection without fundamentally overloading the system.

2.2.8 End-of-life Vehicles

The planned EU Regulation on End-of-Life Vehicles [Q44] aims to further develop the regulatory framework for the vehicle life cycle in a fundamental way. The objective is to make the transition from vehicle use to final deregistration more transparent, more uniform and easier to control. A central element of the regulation is the introduction of a digital “Vehicle Circularity Passport”. For the first time, this is intended to create an EU-wide, uniform and transparent information basis covering the entire life cycle of a vehicle and to consolidate relevant data on use, technical condition, repairs, inspections and recycling.

A key focus of the planned regulation is the clear distinction between vehicles that remain usable and actual end-of-life vehicles. Vehicles that are no longer roadworthy or whose repair is no longer economically justifiable are to be clearly classified as ELVs in future. This is intended to prevent vehicles that are technically no longer roadworthy from continuing to be marketed as used cars or exported to other Member States or third countries.

In this context, the role of the periodic technical inspection (HU/PTI) is significantly strengthened. PTI status is to be linked more closely with national and European vehicle registers in order to provide a robust statement on the roadworthiness of a vehicle. When used vehicles are sold, evidence of roadworthiness will therefore become more important. A valid PTI and transparent information on technical condition will increasingly become prerequisites for a legally secure and traceable transfer of ownership.

The planned export restrictions are particularly important. Vehicles that are in fact to be classified as end-of-life vehicles should no longer be permitted to be exported as used vehicles. The regulation therefore specifically addresses existing grey areas in which technically defective or no longer roadworthy vehicles have been shifted from the European market to third countries. The planned provisions aim to prevent this practice and at the same time reduce environmental and safety risks outside the EU.

Overall, the planned ELV Regulation leads to a much stronger regulatory interlinking of HU/PTI, the used-car trade and technical expert assessments. The technical assessment of vehicle condition thus gains new legal and economic relevance beyond the pure roadworthiness inspection. PTI is increasingly becoming a central component of a holistic system combining road safety, consumer protection, market transparency and the circular economy.

2.3 Thematic clusters

Road safety is largely determined by the interaction of the human, the vehicle and the environment. In addition to human error as the main cause of many accidents, the technical condition of vehicles also plays an important role, particularly at higher vehicle ages. As modern systems become more complex, the importance of regular technical monitoring and proper maintenance also increases. This report summarises current findings from European and international sources on accident statistics, defect statistics and workshop behaviour and examines their interrelationships with regard to the effectiveness of periodic technical inspection (PTI).

2.3.1 Accident statistics

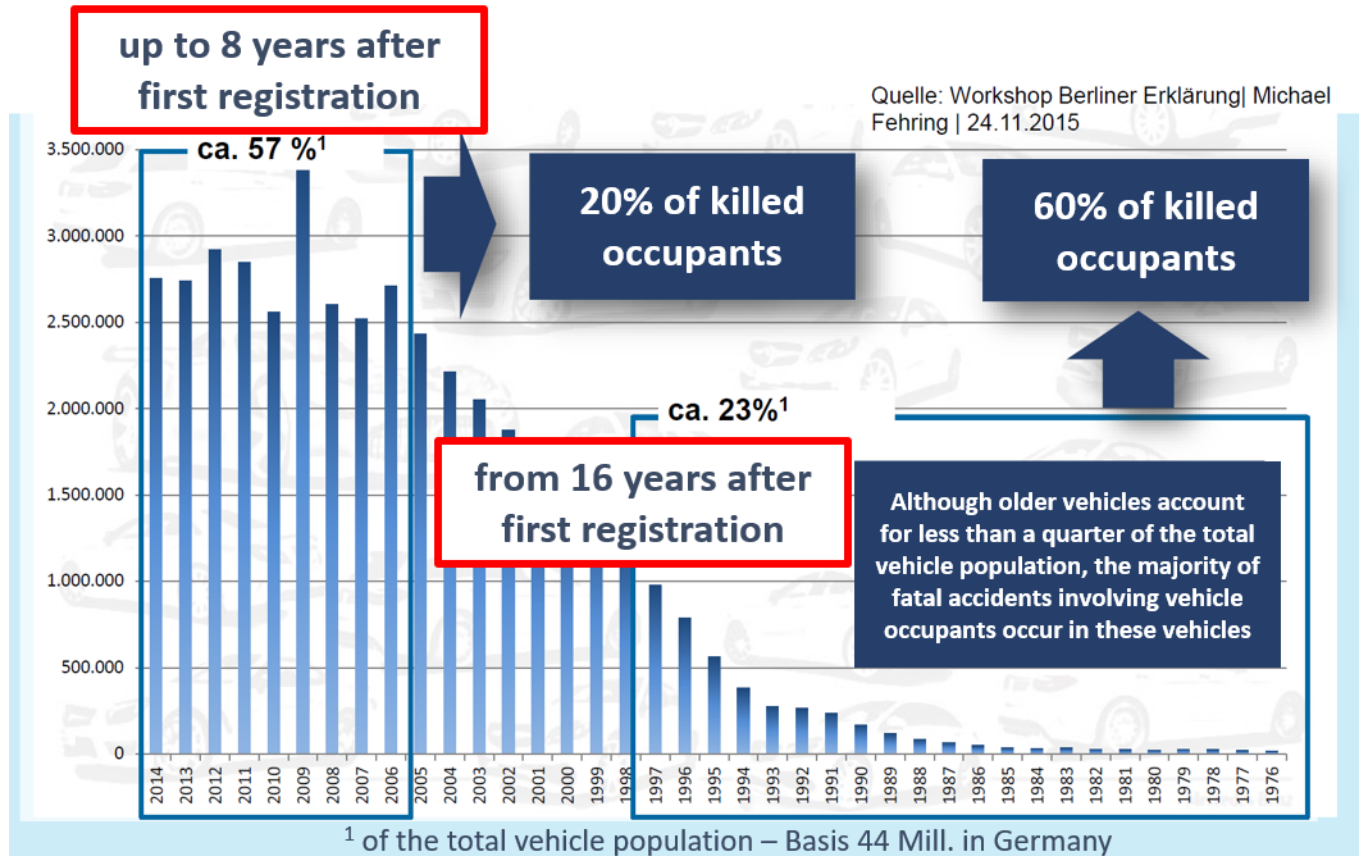
International accident analyses show that the human factor remains the dominant influence in accident occurrence. The study by Thomas et al. (2013) [Q18] in five European countries found that 72% of accidents were attributable to behavioural errors by road users. Observation, planning and interpretation errors were the most frequent. Technical defects of the vehicle were causally involved in only around 4% of cases.

The DEKRA Road Safety Report 2015 [Q26] likewise describes human error as the most frequently directly recorded accident cause. It specifically cites inappropriate speed, right-of-way violations, risky overtaking manoeuvres and driving under the influence of alcohol. At the same time, the report emphasises that long-term improvements in road safety are based on the interaction of various measures. In particular, the introduction and spread of safety systems such as seat belts, airbags, ABS and ESP have made a substantial contribution to reducing accident consequences and preventing accidents.

The Berlin Declaration on Vehicle Safety (VDI 2016) [Q06] made clear that the ageing vehicle fleet represents an increasing safety risk. The average age of passenger cars rose from 6.9 to 9.2 years between 2000 and 2016. It was particularly striking that around 60% of fatally injured passenger-car occupants were travelling in vehicles older than 17 years, although these accounted for only a small share of the total fleet. For vehicles up to nine years old, the share of fatalities was 20% (see Annex 7).

Figure 7: International state of research – share of killed vehicle occupants depending on vehicle age [Q06]

Share of killed vehicle occupants depending on vehicle age



A similar pattern was shown by a large-scale US study by Adanu et al. (2024) [Q12]. Of 15,054 analysed crashes, around 50% of the vehicles involved had technical defects, mainly affecting brakes (42%) and tyres (22%). Vehicles older than ten years were disproportionately involved, particularly where they were inadequately maintained.

Overall, it can be stated that although the human factor has the greatest influence on accident occurrence, the technical condition of vehicles, especially older and poorly maintained vehicles, is a relevant contributory cause. With increasing vehicle age and growing system complexity, the importance of regular technical monitoring for road safety increases.

2.3.2 Defect statistics

The AUTOFORE Report (CITA 2007) [Q05] already showed that the frequency of major defects increases significantly with vehicle age. This trend was particularly evident from a vehicle age of more than six years. An annual periodic technical inspection from eight years was recommended and was assessed as economically beneficial. The report puts the number of accidents caused by technical defects across the EU at 43,000, with older vehicles disproportionately involved. The analyses are based on data from ten EU countries.

A detailed analysis from Spain by Díaz López et al. (2018) [Q15] showed for 2016 that 17.45% of vehicles had serious defects. The defect rate rose almost linearly with age, from 10% for new vehicles to 28% for passenger cars more than ten years old. A sharp increase occurred between five and six years. Lighting, axles, tyres, wheels and suspension were frequently affected. According to the calculation, regular PTI prevented more than 17,000 accidents and 133 fatalities.

A Europe-wide analysis by Hudec et al. (2021) [Q14] examined the results of periodic technical inspections in ten EU Member States. It showed that the share of vehicles with at least major or dangerous defects varies significantly between countries despite a harmonised European legal framework. Reported rates ranged from 2% in Poland to 20.8% in Germany. The authors expressly point out, however, that these differences cannot be attributed solely to the technical condition of the vehicle fleets. National characteristics of inspection systems, inspection quality, control mechanisms and the design of technical monitoring also influence the results.

Irrespective of differences between Member States, the study shows a consistent relationship between vehicle age and defect frequency. In the national datasets evaluated, the share of vehicles with major or dangerous defects increased significantly with vehicle age. The results therefore confirm the relationship between vehicle age and the probability of technical defects described in numerous other studies.

Edwards and Hemans (CITA 2024) [Q13] investigated the relationship between PTI findings and accident-relevant defects. While dangerous defects are found in around 50% of standard inspections, this share is 88% in in-depth collision analyses. This makes clear that not all technically relevant defects are detected during routine inspections, highlighting the importance of qualified inspectors and modern inspection technology.

The DEKRA Road Safety Report 2015 [Q26] shows a clear relationship between vehicle age and the frequency of technical defects. The share of vehicles with identified defects rises from around 28% for vehicles under three years old to around 71% for vehicles aged 7-9 years and to around 87% for vehicles aged 13-15 years. The findings thus confirm the

relationship observed in numerous PTI statistics between increasing vehicle age and rising defect frequency.

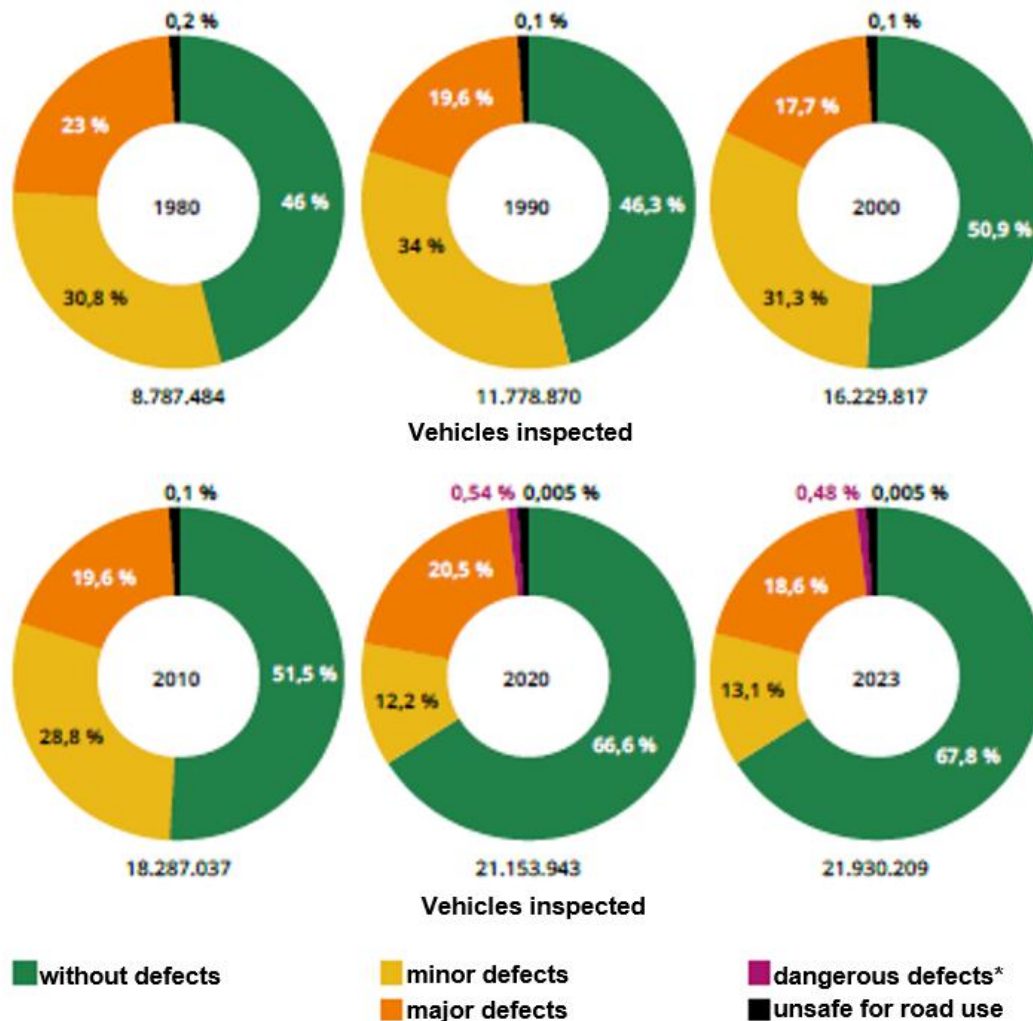
The current DEKRA Road Safety Report 2025 [Q27] shows that the share of technical defects as an immediate accident cause is low, but that preventive control is becoming increasingly important. Examples from Turkey and the United States show that the introduction or tightening of PTI led to significant decreases in accident-causing technical defects. In Turkey, road fatalities fell by around 40% after the introduction of PTI in 2008, while in Texas the share of technical accident causes fell from 12% to 4% after vehicle inspection was introduced.

Figure 8: International state of research – defect statistics in Germany over the years 1980-2023 (KBA)



Passenger car PTI in Germany

The results of the passenger car PTI surveys from recent years show a positive trend: the number of vehicles with no defects has increased significantly, whilst the number of vehicles with significant defects has fallen.

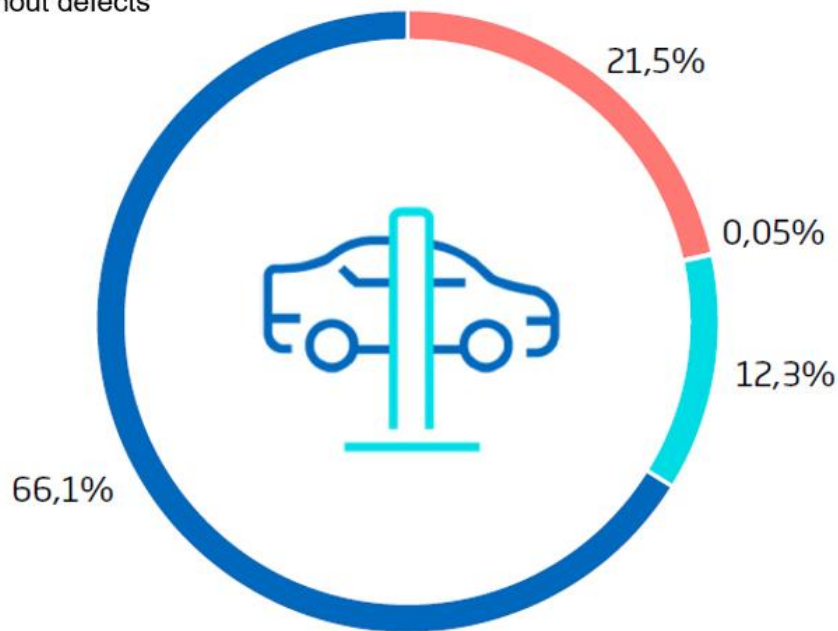


*new classification since the 2018

Quelle: Kraftfahrt-Bundesamt

Figure 9: International state of research – defect statistics 07/24 to 06/25 (TÜV Report 2026, [Q45])

- major and dangerous defects
- unsafe for road use
- minor defects
- without defects



Quelle: TÜV-Report 2026

The results of the TÜV Report 2026 [Q45] reproduced in Figure 9 show the high relevance of technical defects in the fleet for the PTI period from July 2024 to June 2025, based on around 9.5 million inspections. According to the report, around every third passenger car has a defect. In addition, every fifth vehicle fails the periodic technical inspection. The findings concerning dangerous and unroadworthy vehicles are particularly safety-critical: around 135,000 vehicles are reported with dangerous defects. Overall, around 12,000 vehicles are classified as unroadworthy and are immediately taken out of service.

In summary, the defect statistics show that vehicle age, maintenance intensity and inspection quality are decisive influencing factors for road safety. Regular and high-quality PTI demonstrably reduces the number of serious defects in the vehicle fleet.

2.3.3 Workshop behaviour

The DAT Reports 2023-2025 [Q21, Q22, Q23] provide a detailed picture of maintenance and repair behaviour among German passenger-car owners. The evaluations show a high willingness to maintain vehicles, although with increasing vehicle age there is a shift from authorised brand workshops to independent workshops.

According to the DAT Report 2023, 78% of vehicles under four years old are maintained in authorised brand workshops, but only 23% of vehicles older than ten years. The share of independent workshops rises to 67%, while owner-performed work plays a small but constant role at around 10%. The average maintenance frequency was 0.98 per year.

In the DAT Report 2024, the maintenance level remained stable: 74% of owners had inspections carried out regularly, usually once a year. Repairs occurred on average 0.39 times per year. 91% of respondents stated that their vehicle must always be in technically perfect condition, and 73% do not postpone maintenance for cost reasons.

The DAT Report 2025 confirmed this trend and, with 1.03 maintenance operations and 0.41 repairs per year, showed a slightly higher maintenance level. For vehicles aged six years and over, 59% of maintenance and repair work is already carried out in independent workshops. Despite rising costs, 91% of owners value technical reliability, and more than half use original spare parts.

Overall, maintenance behaviour appears stable and responsible, but as vehicle age increases it increasingly takes place outside the authorised brand and control sphere. This may create differences in information and quality of maintenance that affect vehicle condition and inspection results. The data evaluated indicate that repairs occur on average roughly every two years.

When interpreting the results, it must be considered that the DAT Report is based on survey data. The reported maintenance and repair expenditure therefore reflects the stated behaviour of vehicle owners and cannot be equated directly with the actual technical condition of the vehicles.

2.4 Conclusion on the international state of research

The available research and investigations show that periodic technical monitoring has been part of road-safety strategy at national and European level for many years. At the same time, the framework conditions are changing due to the ageing of the vehicle fleet, new vehicle technologies and efforts towards stronger harmonisation at European level.

The analysis of accident occurrence makes clear that human error remains the dominant accident cause. Technical defects account for a significantly smaller share of overall accident occurrence by comparison, but they can play a safety-relevant role, particularly in

older vehicles. At the same time, national and international defect statistics consistently show that the frequency of technical defects increases with vehicle age.

In addition, the analyses indicate a continuing ageing of the vehicle fleet in Germany and many European countries. In parallel, structures relating to maintenance, repair and vehicle use are changing. The available data show differences between vehicle age groups and between maintenance pathways used, but they do not in all cases allow conclusions to be drawn about the actual technical condition of vehicles.

The evaluation of European regulations makes clear that, despite common minimum requirements, Member States pursue different approaches to inspection intervals and inspection systems. Against this background, the current reform proposals of the European Commission must also be understood: in addition to possible changes to inspection intervals, they address the further development of inspection procedures, the consideration of new vehicle technologies and the digitalisation of administrative and inspection processes.

Overall, the results illustrate the interrelationships between vehicle age, technical condition, maintenance behaviour and road safety. However, the studies and positions considered also show that the assessment of possible changes to inspection intervals is not unequivocal and depends on the underlying assumptions, data bases and methodological approaches.

3. Descriptive analysis of the vehicle fleet

The investigation serves to classify descriptively the relationships between vehicle age, technical condition, usage patterns and accident occurrence on the basis of available fleet, defect and accident statistics. The aim of this section is to present and classify empirical findings in a structured way without directly deriving statements about the effectiveness of individual transport-policy measures or inspection regimes.

The data sources considered in this chapter describe the technical condition of vehicles at defined points in time, for example during the periodic technical inspection, the development of defect frequencies over vehicle age and the statistical recording of accident causes. These data allow statements about distributions, frequencies and developments over time, but in themselves do not provide causal evidence of relationships between inspection frequencies, technical condition and accident prevention.

The analyses show that both defect statistics and accident statistics are subject to methodological limitations. Technical defects are recorded only to a limited extent in official accident recording and often cannot be clearly identified as the sole accident cause. At the same time, PTI results primarily represent the technical condition at the time of inspection and allow only limited conclusions about the condition of vehicles throughout the entire inspection interval.

Against this background, a descriptive approach is adopted. The findings presented serve as an empirical starting point for describing possible relationships without presupposing causal effects. On the basis of the data considered, statements on the actual effect of PTI on accident occurrence and road safety are possible only to a limited extent.

Table 9: Descriptive analysis – overview of the accessible data sources evaluated

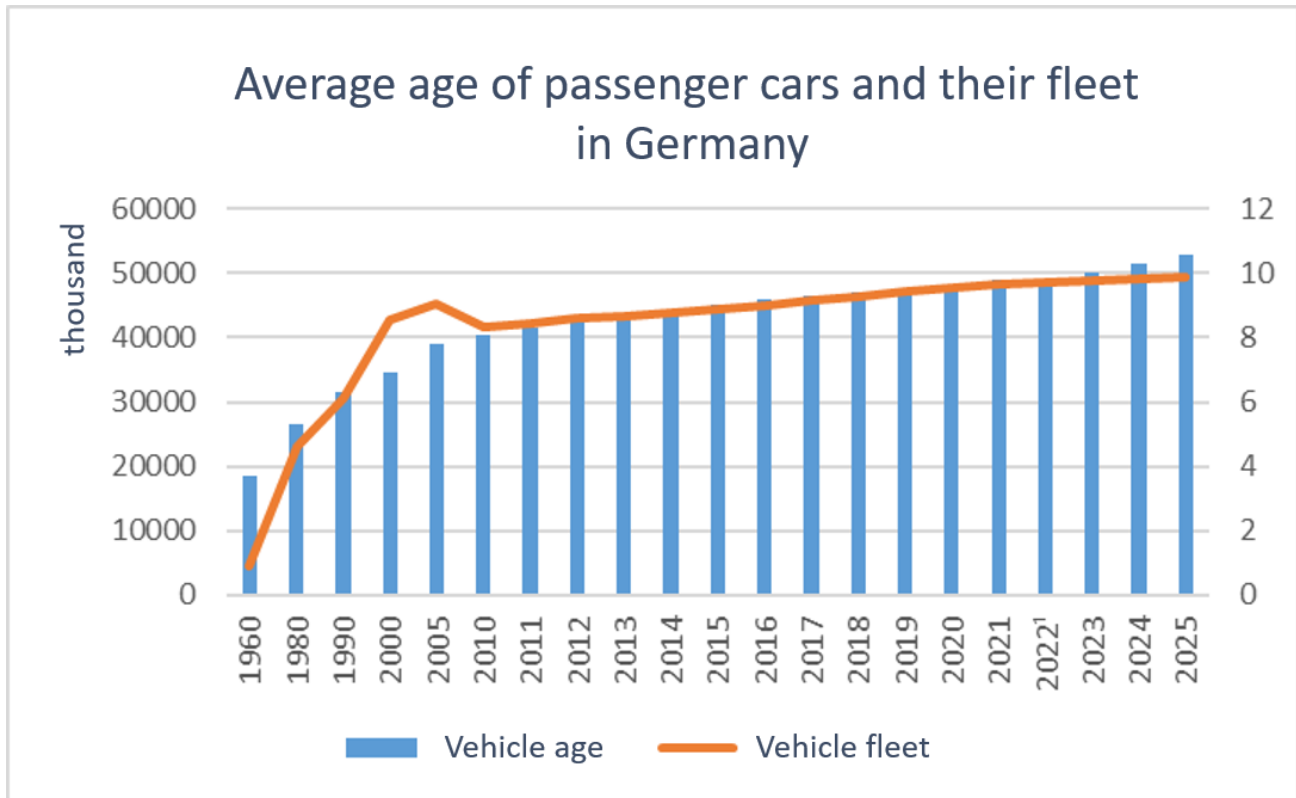
Data Source	Period	Focus
KBA (German Federal Motor Transport Authority)	2003–2025	Vehicle fleet, vehicle age, owner age
Destatis (Federal Statistical Office of Germany)	2014–2024	Crash involvement, vehicle mileage
TÜV / DEKRA	2014–2026	Periodic technical inspection (PTI) results, defect rates
DAT (German Automobile Trust)	2023–2025	Maintenance, repairs, costs
ADAC	2019–2024	Breakdown statistics
ACEA (European Automobile Manufacturers' Association)	2013–2023	European comparison

3.1 Vehicle fleet and vehicle age

The age structure of the German passenger-car fleet shows a high share of older vehicles. At more than 25%, passenger cars aged 5 to 9 years constitute the largest vehicle group. At the same time, 23.9% of registered passenger cars are already 15 to 29 years old. Overall, only around 52% of the fleet is younger than ten years.

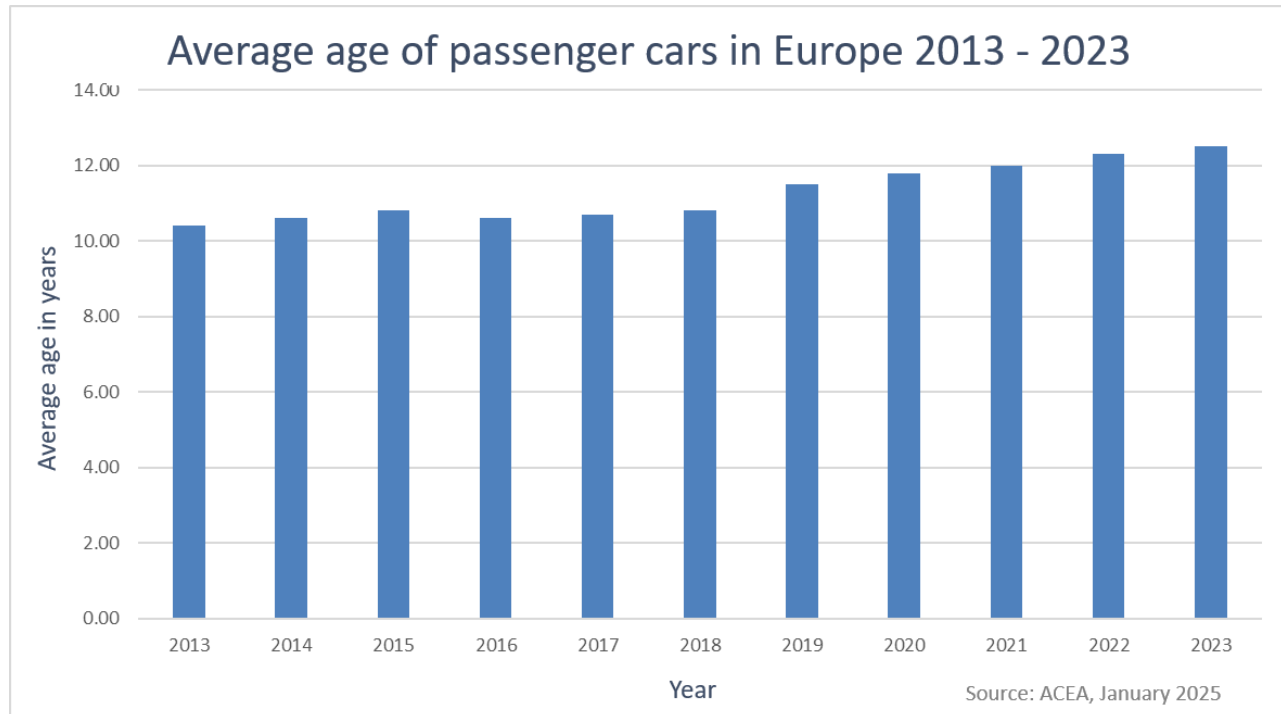
In parallel, the development of the average age is described (Figure 10). The average age of passenger cars registered in Germany continued to rise in 2024 and reached a new record of 10.6 years in January 2025 (source: Statista/KBA).

Figure 10: Descriptive analysis – average age of passenger cars and fleet in Germany from 1960 to 2025 (source: Statista 2025)



In a European comparison, clear differences are evident with regard to the average vehicle age and the age structure of national vehicle fleets. Germany is in the European midfield. At the same time, the Europe-wide ageing trend continues: the average age of passenger cars in the European Union also rose further in 2023, reaching around 12.5 years. Since 2016, a continuous increase in the average vehicle age within the EU has thus been observed [cf. Q46].

Figure 11: Descriptive analysis – average age of passenger cars in the EU from 2013 to 2023 (source: ACEA, 2025 [Q46])

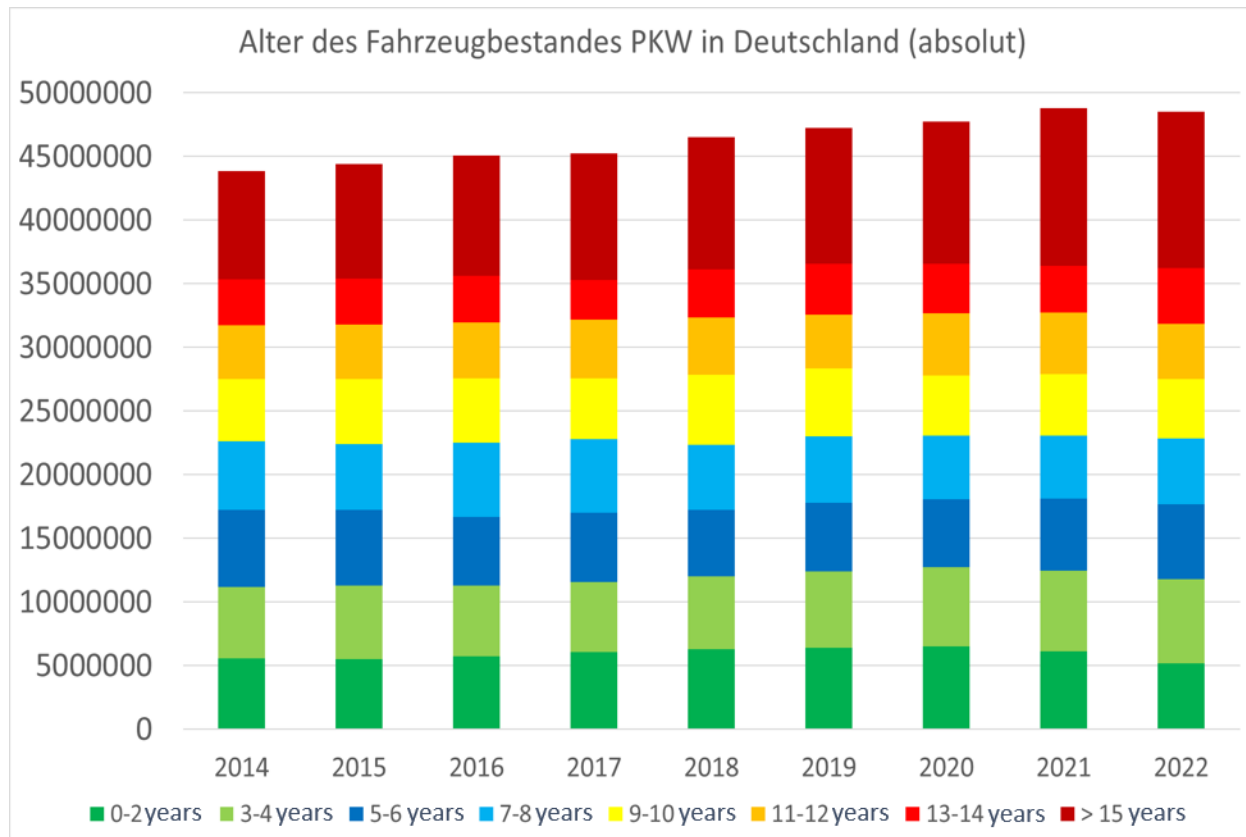


3.2 Development of vehicle age and owner demographics

Figure 12 shows the development over time of the age structure of the vehicle fleet and changes in the owner structure. The shares of passenger cars up to a vehicle age of around 12 years have developed largely stably over the years considered. A slight increase is apparent in the 13- and 14-year age groups, while the clearest increases occur among vehicles aged 15 years and older. The ageing of the vehicle fleet is therefore shaped particularly by the increasing share of older vehicles, whose fleet shares have continuously increased over several years.

The age structure shown covers the entire registered passenger-car fleet regardless of owner type. A separate consideration of company, leasing or rental vehicles, which are more frequently represented particularly in the younger vehicle age classes, is not carried out.

Figure 12: Descriptive analysis – passenger-car fleet by vehicle age (KBA)



Parallel to the development of vehicle age, a change in the age structure of vehicle owners is also evident. The share of passenger cars registered to persons aged 60 and over is increasing, while the shares of younger age groups remain largely constant. The results describe the age structure of the owners of registered vehicles, but do not allow conclusions about the number of vehicles per person or actual usage behaviour.

Overall, the descriptive statistics show structural ageing at two levels:

- ageing of the passenger-car fleet, especially the increase in vehicles older than 15 years;
- ageing of the owner population, with an increase in owners aged 60 and over.

While passenger cars up to ten years old remain structurally stable by age, the share of passenger cars older than 15 years is growing significantly; in parallel, the share of owners aged 60 and over is increasing.

Figure 13: Descriptive analysis – vehicle fleet by age of vehicle owner (KBA)

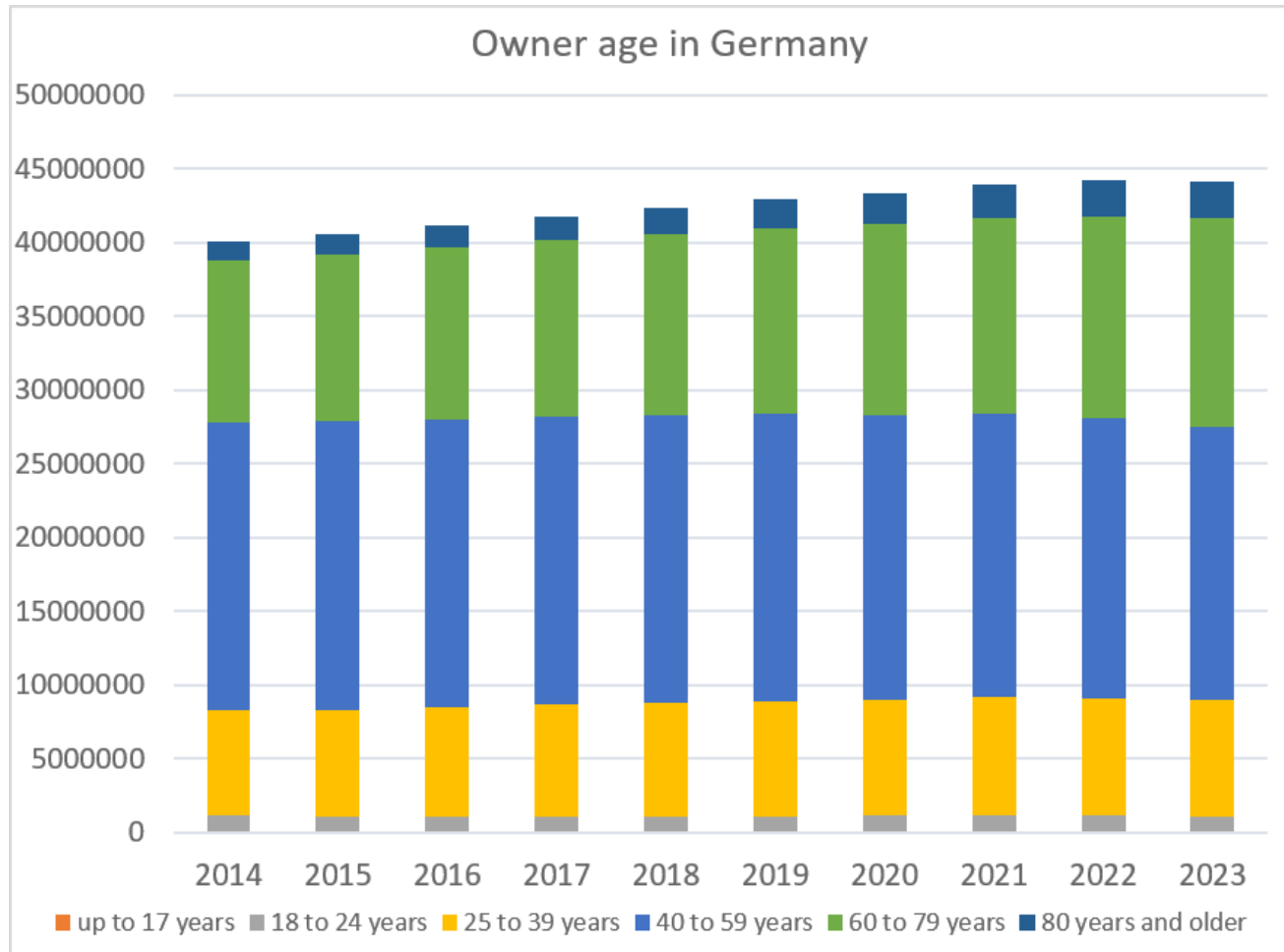
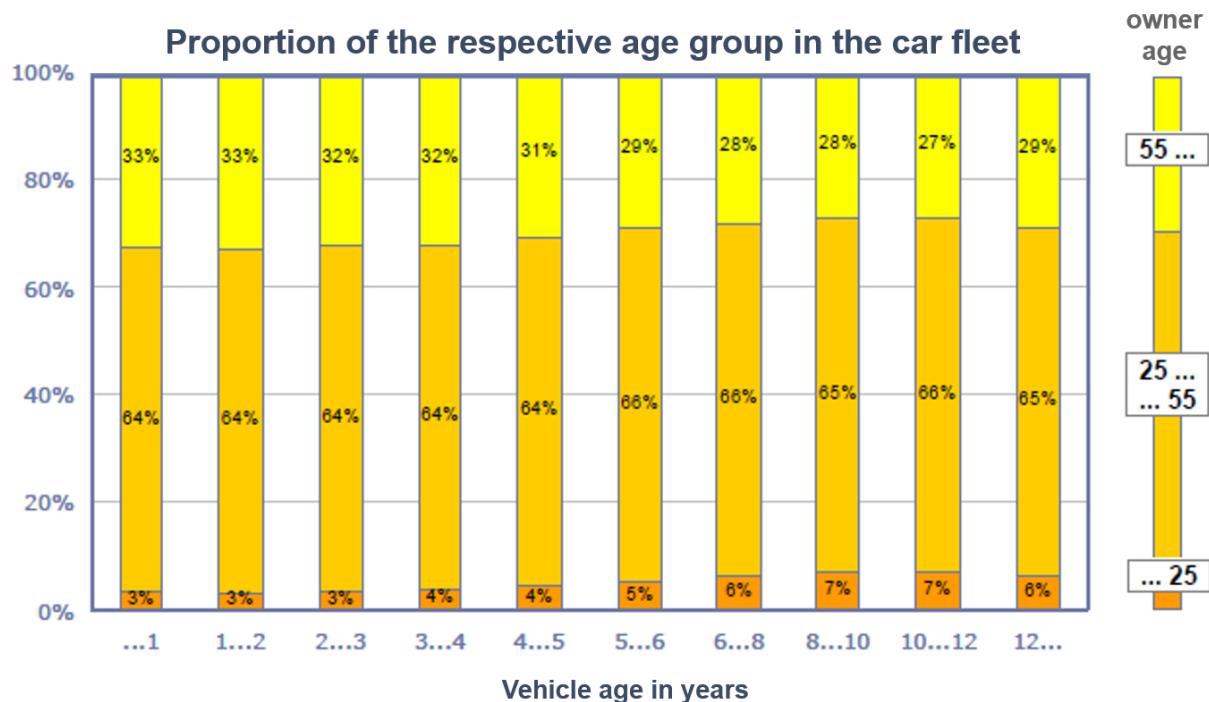


Figure 14: Descriptive analysis – share of passenger-car fleet by vehicle age and age of vehicle owner (KBA, 1999)



3.3 Deregistration of vehicles

The evaluations of age-dependent deregistration show the extent to which vehicles no longer remain in the fleet in specific age segments. For descriptive purposes, an age-dependent rate of vehicles no longer presented for PTI is defined.

$$\text{Rate of vehicles "not presented"} = \frac{\text{Number of vehicles not presented}}{\text{Number of vehicles not presented} + \text{Number of vehicles presented (before the inspection deadline expired)}}$$

The PTI data for the period 2013-2021 show a clear age-dependent increase in this rate. As vehicle age increases, the share of vehicles no longer appearing in the PTI system continuously rises and reaches its maximum among very old vehicles.

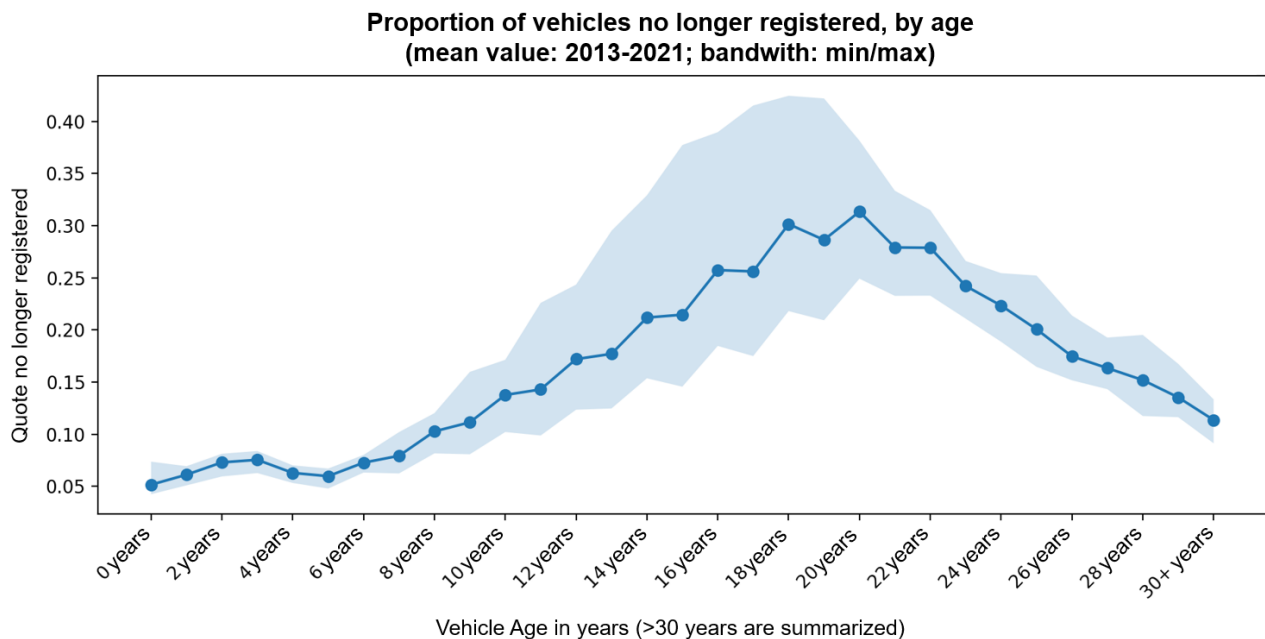
Figure 15 illustrates that deregistration is not distributed evenly across all age classes. At younger vehicle ages, the share of deregistered vehicles is low and relatively stable. With increasing vehicle age, however, the share of vehicles leaving the fleet rises significantly.

Particularly in higher age segments, an increasing concentration of deregistrations is evident. This corresponds to the typical life-cycle pattern of a vehicle: during the first years, regular use predominates, whereas with increasing age the probability rises that vehicles will be permanently withdrawn from traffic.

The evaluation therefore represents a descriptive lifetime distribution of the vehicle fleet. It allows statements about the age at which vehicles typically leave the fleet, without permitting conclusions about the specific reasons for deregistration. Technical condition, economic aspects, repair costs, owner decisions or regulatory influences cannot be derived directly from the presentation.

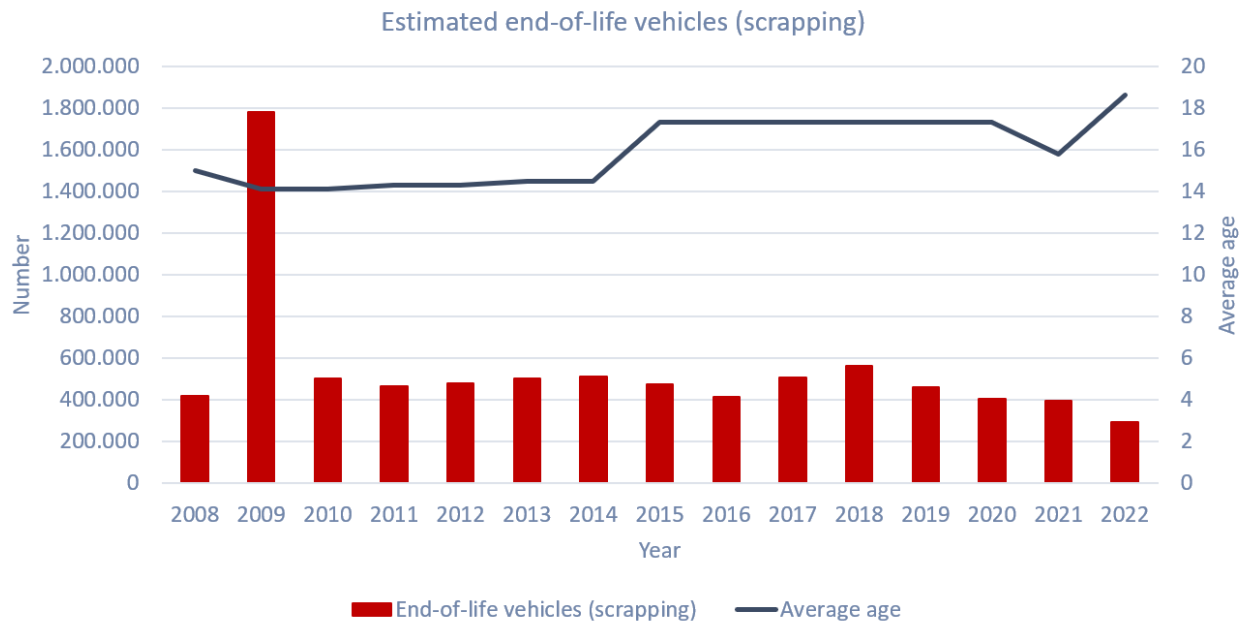
Overall, Figure 15 shows that deregistration has a strongly age-dependent structure and becomes clearly concentrated as vehicle age increases.

Figure 15: Descriptive analysis – deregistration, share of vehicles no longer presented by age (FSD)



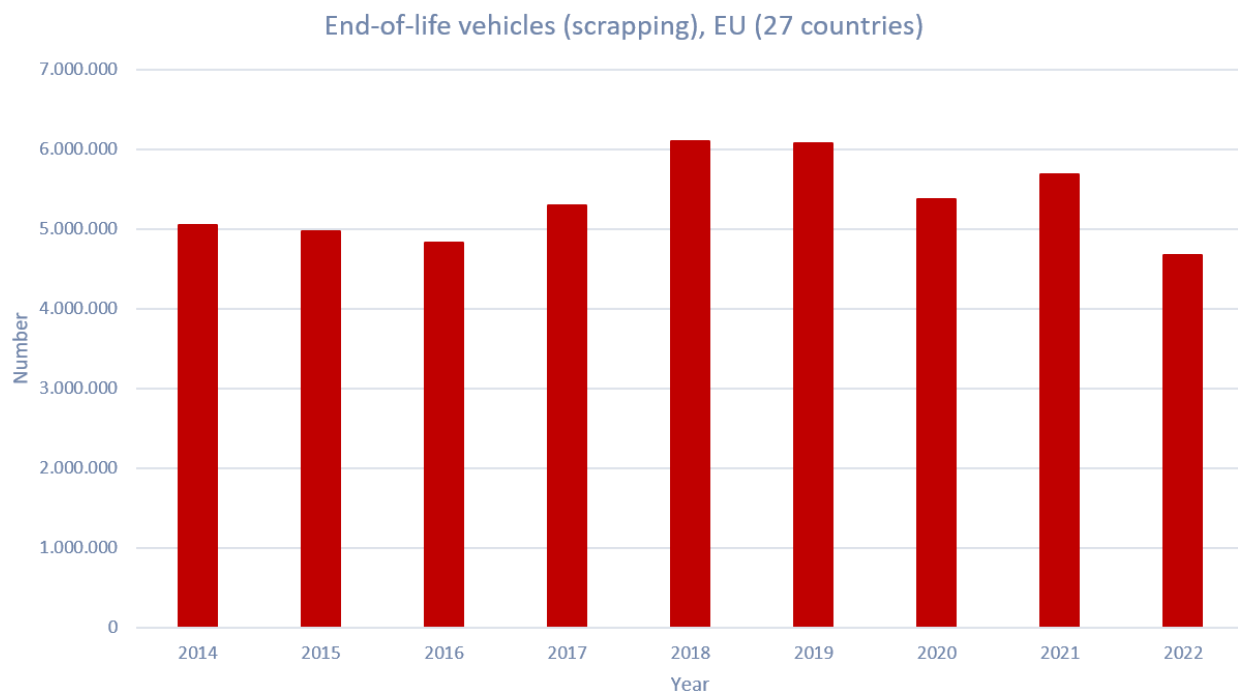
The national end-of-life vehicle statistics (source: annual report on end-of-life vehicle recovery rates, BMUV) show significant fluctuations in scrappage figures for the period 2008-2022. The number of end-of-life vehicles (scrappage) ranges between around 1.4 and 2.0 million vehicles per year during the period considered. The estimate of final withdrawals (scrappage plus export) is significantly higher, at around 2.5 to 3.3 million vehicles per year. The average age of scrapped vehicles is around 16 to 18 years. The figures show that scrappage reflects only part of the final exits from the fleet (Figure 16).

Figure 16: Descriptive analysis – estimate of end-of-life vehicle scrapping in Germany (Federal Ministry for the Environment)



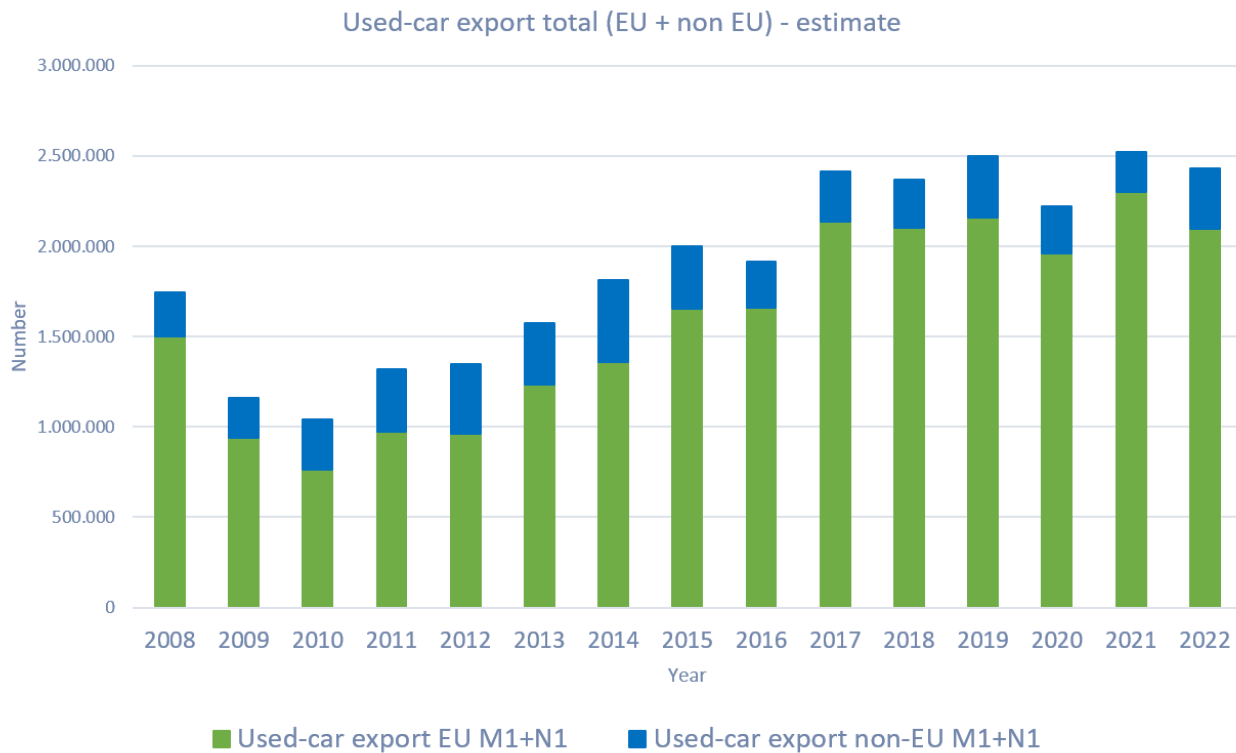
For the EU-27 (source: Eurostat), annual scrapping figures for the period 2014-2022 are in the range of around 5 to 6.5 million end-of-life vehicles per year. Fluctuations are also evident here, particularly in 2020/2021. The EU figures show that the national development is embedded in a broader European context.

Figure 17: Descriptive analysis – end-of-life vehicle scrapping in the EU (Eurostat)



Annual export figures (M1 + N1) for Germany in the period 2008-2022 are around 1.5 to 2.7 million vehicles per year. A distinction is made between exports to EU countries and exports to non-EU countries. The figures make clear that exports account for a substantial share of exits from the national vehicle fleet. It is therefore clear that not every deregistered vehicle is scrapped. A significant share is exported and continues to be used outside Germany.

Figure 18: Descriptive analysis – estimate of used-vehicle exports



3.4 Annual mileage

For Germany in 2017, the following values apply:

- Passenger cars owned by persons under 20 years of age: average 10,294 km per year.
- Passenger cars owned by persons aged between 30 and 59 years: average 12,200 km per year.

The average annual mileage in the middle age group is therefore around 1,906 km higher than among those under 20. The data show that usage behaviour differs according to owner age. Passenger cars owned by persons of middle working age show the highest average annual mileage, while younger owners are significantly below this level.

Figure 19: Descriptive analysis – mileage in Germany by age groups 2017 (Check24, 2018, ID 413306)

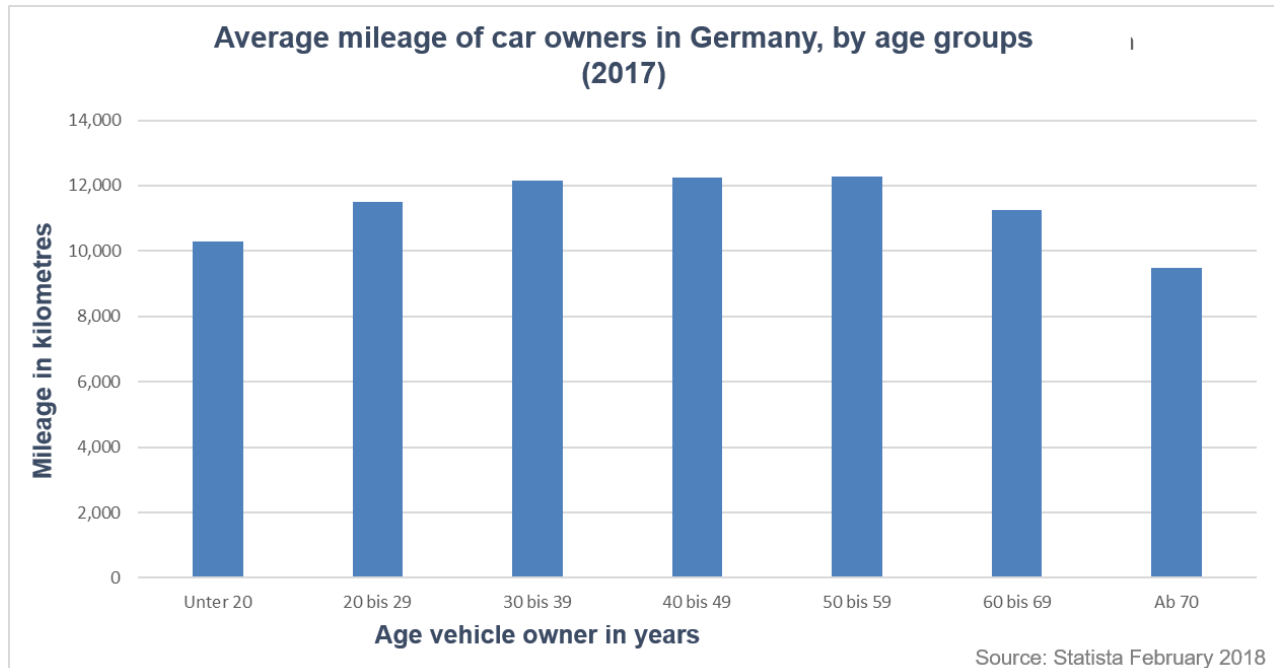


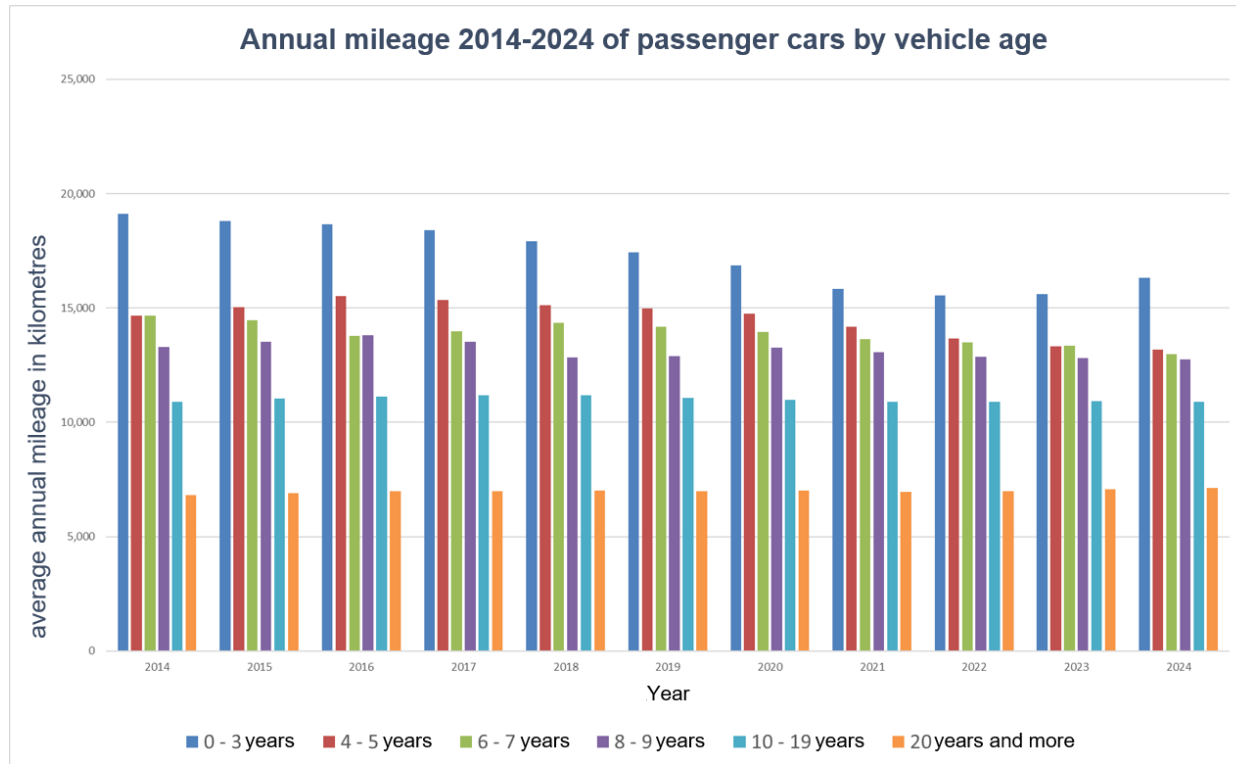
Figure 20 shows annual mileage depending on vehicle age for the years 2014 to 2024. For 2024, the following values are obtained:

- Young passenger cars (0-3 years): average 16,300 km per year.
- Passenger cars aged 10 years and over: average 10,800 km per year.
- Passenger cars aged 20 years and over: average 7,100 km per year.

This results in a decrease of 5,500 km per year between vehicles aged 0-3 years and vehicles older than 10 years, and a decrease of 9,200 km per year between vehicles aged 0-3 years and vehicles older than 20 years.

The data show a clear, non-linear decline in annual mileage with increasing vehicle age. In addition, the average annual mileage of old passenger cars was largely constant over the years, whereas the annual mileage of young passenger cars is declining. This changes not only the age structure of the fleet, but also the intensity of use within the age segments.

Figure 20: Descriptive analysis – annual mileage 2014-2024 by vehicle age (KBA, traffic in kilometres, 2025)



Source: KBA, Traffic in Kilometres, 2025

The combination of the data shows two different but interconnected structural effects: mileage varies by owner age, and mileage decreases significantly with increasing vehicle age. Young vehicles are used much more intensively than older vehicles. Vehicles more than 20 years old are used, on average, less than half as intensively as new vehicles.

3.5 Breakdown statistics

Figure 21 shows the percentage distribution of breakdown causes by component group for the period 2019 to 2024. The basis is ADAC breakdown data.

1. Starter battery (dominant cause)

The starter battery is by a considerable margin the most frequent cause of breakdowns in all years considered. Its share ranges from around 42% in 2019 to around 46% in 2020/2021, around 43% in 2022, around 44% in 2023 and around 45% in 2024. Thus, consistently around 4 to 4.5 out of 10 breakdowns are attributable to the battery. Despite slight fluctuations, the share remains structurally high over the entire period; no long-term decline is apparent.

2. Engine, engine management, injection, ignition etc.

This component group is the second-largest cause of breakdowns. Its share is relatively stable, around 26% in 2019 and around 22-24% in 2020-2024. Compared with 2019, a slight decline of around 3-4 percentage points can be observed. Overall, however, the share remains constant at about one quarter of all breakdowns.

3. Alternator, starter motor, onboard electrical system, lighting

This category is in the range of around 10-11% over the entire period. Fluctuations are small and no clear trend is apparent. The share remains structurally stable.

4. Tyres

Tyre-related breakdowns remain constant in the range of around 7-8%. Here too, only minor annual changes are evident. The share remains low compared with electrical and battery-related causes.

5. Keys, locks, immobiliser

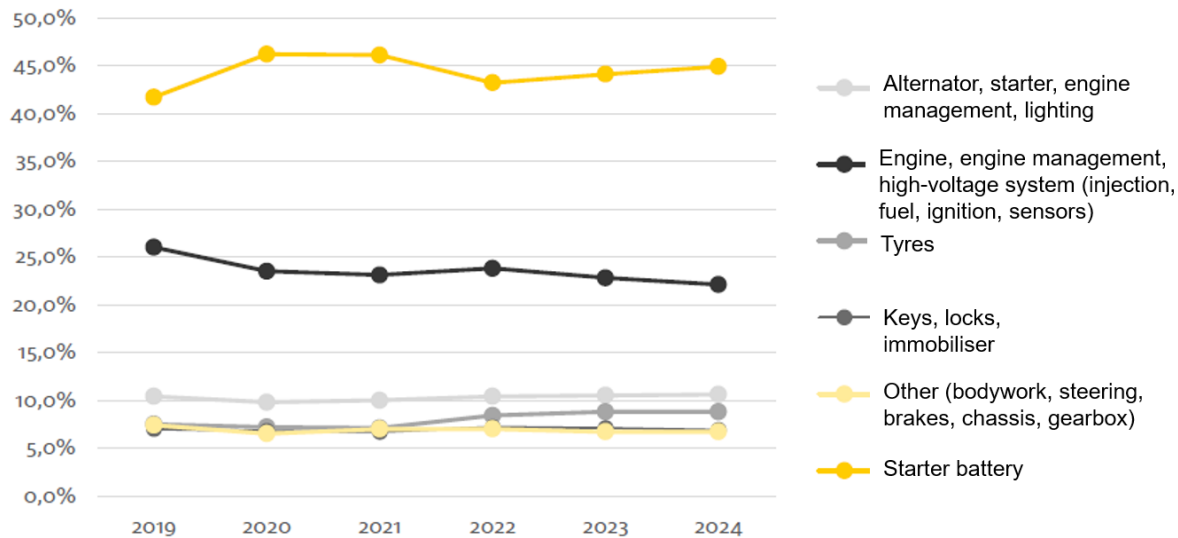
The share is in the range of around 7-9%. Slight fluctuations are visible, but without any structural trend.

6. Other (body, steering, brakes, chassis, transmission)

This group remains constant at around 6-7%. Classic mechanical safety components such as brakes and chassis therefore play a considerably smaller role in breakdown occurrence than battery- and electronics-oriented systems.

Figure 21: Descriptive analysis – breakdown statistics in Germany 2019-2024, components (source: ADAC Breakdown Statistics, 2025)

Breakdown statistics in Germany 2019–2024



These percentages of breakdowns were attributed to individual components in the years 2019–2024

Source: ADAC Breakdown Statistics 2025

Across the entire period 2019-2024, a stable structure of breakdown causes is evident: around 45% relate to the starter battery, around 22-25% to engine and engine-management systems, electrical/onboard-network systems are around 10%, and mechanical components such as brakes and chassis are below 10%.

Figure 22 shows the development of the breakdown index by vehicle age (2019-2024). The evaluation is based on the ADAC breakdown statistics and considers vehicles up to an age of ten years. Vehicles are ranked relative to one another on the basis of their breakdown index: the best 15% (lowest breakdown frequency) are shown in dark green, and the worst 5% in red. The intermediate ranges are graded evenly in light green, yellow and orange.

Across registration years, a clear age-dependent increase in the breakdown index is evident. While young vehicles, for example registration years 2022-2020, are predominantly in the dark-green or light-green range, the values rise markedly with increasing age. For vehicles first registered in 2015 to 2017, corresponding to an age of eight to ten years, breakdown index values reach more than 28 to more than 30 breakdowns per 1,000 vehicles. Orange and red ratings occur much more frequently in these age classes.

This shows a pronounced increase in breakdown frequency in the segment of nine- to ten-year-old passenger cars. The data demonstrate a clear relationship between vehicle age

and susceptibility to breakdowns within the age corridor up to ten years. It should be noted, however, that the influence of manufacturer mobility guarantees is not reported separately in the published ADAC breakdown-statistics evaluations.

Figure 22: Descriptive analysis – breakdown index, breakdown statistics in Germany 2019-2024 (source: ADAC Breakdown Statistics 2025)

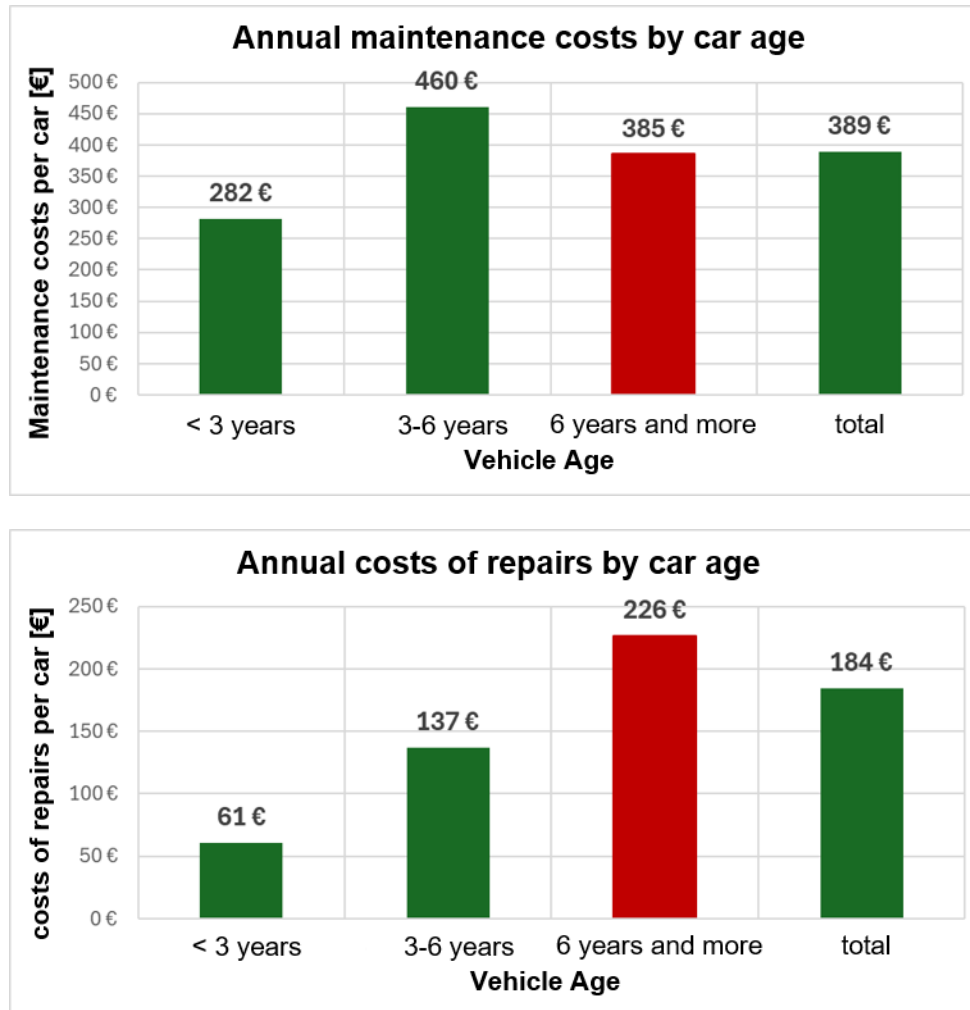
Breakdown statistics in Germany 2019–2024 Source: ADAC Breakdown Statistics 2025

Year of first registration	2022	2021	2020	2019	2018	2017	2016	2015
Top 15 2024	≤1,2	≤2,0	≤3,0	≤4,3	≤6,8	≤7,6	≤8,7	≤10,7
	≤6,1	≤9,4	≤12,3	≤13,1	≤13,8	≤15,2	≤15,2	≤16,5
	≤10,9	≤16,9	≤21,5	≤21,9	≤20,9	≤22,9	≤21,8	≤22,3
	≤15,8	≤24,3	≤30,8	≤30,7	≤27,9	≤30,5	≤28,3	≤28,1
Bottom 5 2024	>15,8	>24,3	>30,8	>30,7	>27,9	>30,5	>28,3	>28,1

3.6 Maintenance and repair behaviour

The DAT Report 2025 shows current maintenance and repair behaviour in Germany. Vehicles aged 3-6 years incur the highest maintenance costs. Older vehicles, i.e. vehicles older than six years, incur the highest repair costs. As vehicle age increases, the cost focus shifts from planned maintenance towards unplanned repairs. The overall cost structure changes depending on age, but the basic pattern over time does not. Costs systematically shift from maintenance to repair as vehicles age.

Figure 23: Descriptive analysis – maintenance and repair behaviour 2024 (source: DAT Report 2025)



Source: DAT Report 2025

3.7 Accident and defect statistics

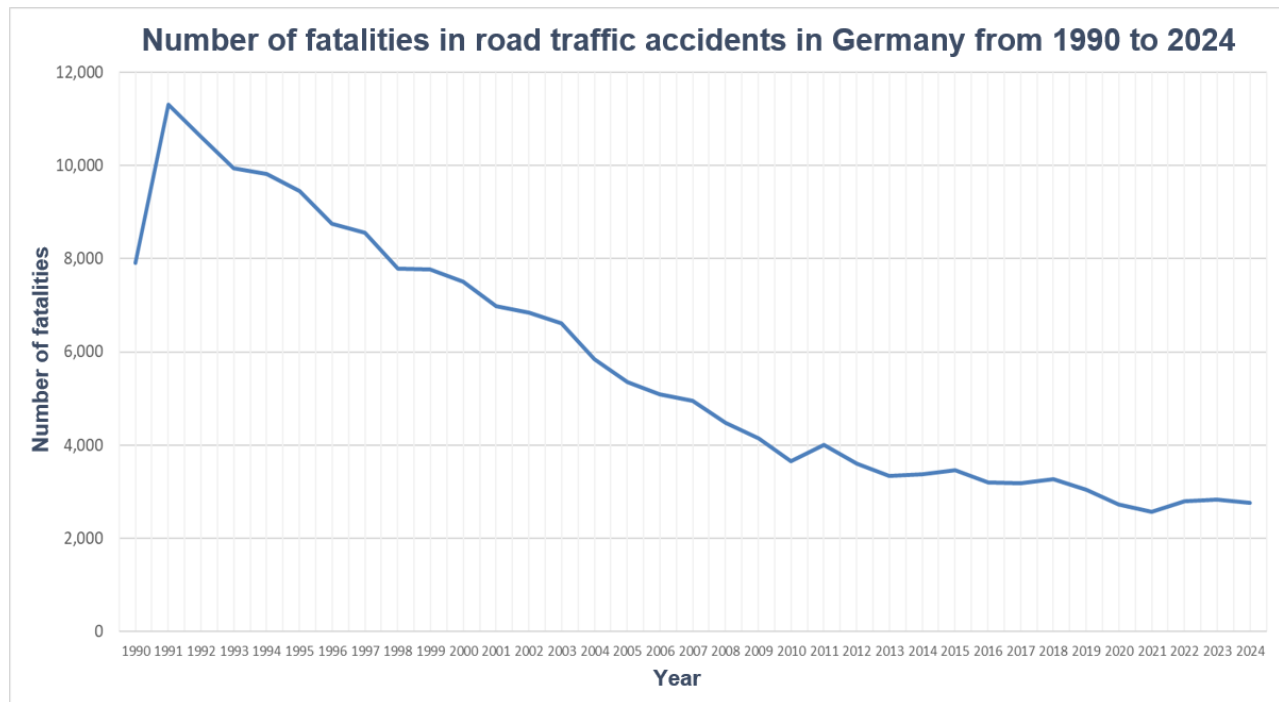
3.7.1 Development of road fatalities in Germany (1990-2024)

The long-term development of the number of road fatalities in Germany shows two clearly distinguishable phases. Between 1990 and around 2010, a clear and almost continuous decline is evident. During this period, the number of fatalities fell from more than 11,000 in the early 1990s to around 3,600 to 4,000 around 2010, corresponding to a decline of around 68%.

Since around 2010, the development has been much flatter. Since then, the number of road fatalities has fluctuated at a comparable level between around 2,500 and 3,500 per year. A further structural and sustained decline is not apparent during this period; overall, since 2010 the reduction has been only around 24%.

The curve has therefore shown relative stagnation for around 15 years. While the first two decades were characterised by substantial safety gains, no comparable momentum has been observed in the more recent past. According to DESTATIS (DESTATIS 2025, code 46241-0007), drivers and passengers of passenger cars constitute the largest group of persons fatally injured in road traffic.

Figure 24: Descriptive analysis – number of persons killed in road accidents in Germany 1990-2024 (source: DESTATIS, 2025, code 46241-0007)



3.7.2 Passenger-car drivers involved in and principally responsible for injury accidents by age

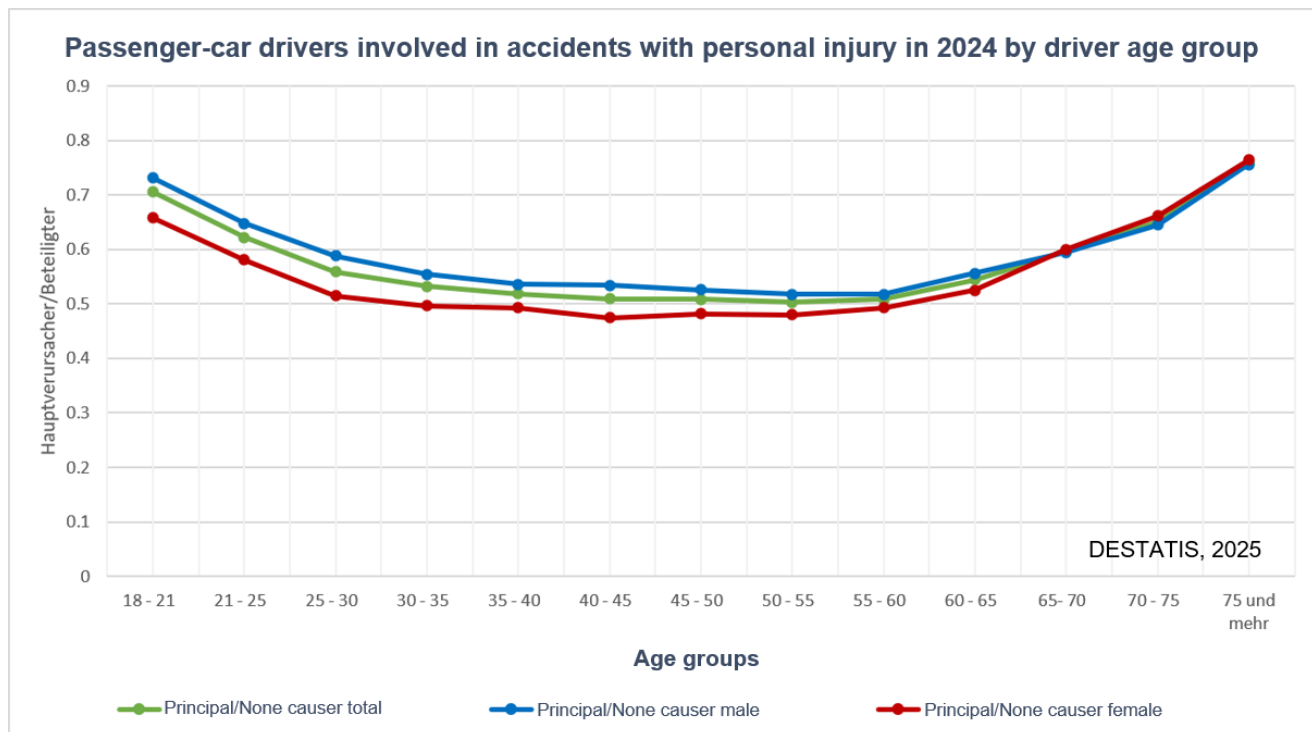
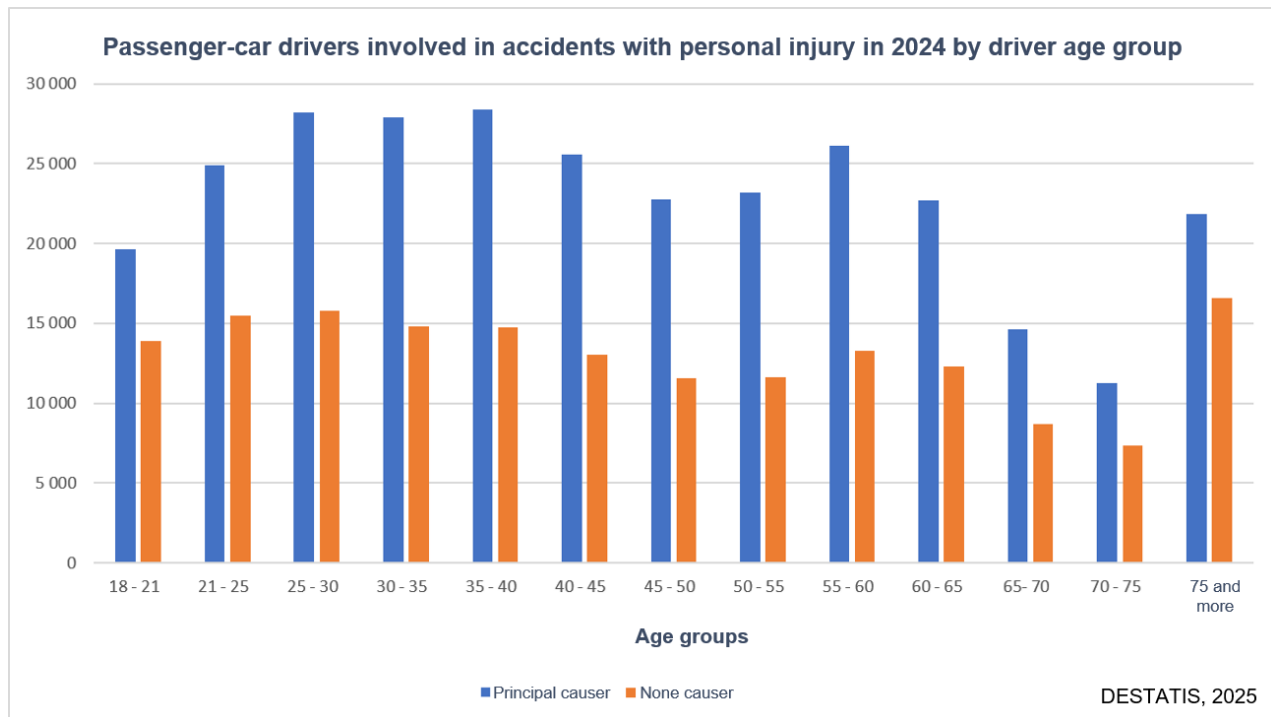
The evaluation of Destatis data for 2024 (DESTATIS, 2025, Table UJ 8) shows a clear age dependency in involvement in, and principal causation of, traffic accidents involving personal injury.

Passenger-car drivers involved (n = 311,973): the highest number of passenger-car drivers involved is found in the middle age groups. Particularly notable are the groups aged 55-60 years with around 26,000 involved persons (approximately 8.3%); 25-30, 30-35 and 35-40 years with around 28,000 to 28,400 involved persons each (approximately 9% each); and 60-65 years with around 22,700 involved persons (approximately 7.2%). Significantly lower values are shown for persons under 18 years (around 400 involved persons), 65-70 years (around 14,600) and 70-75 years (around 11,300). Absolute involvement therefore broadly follows the driving and population structure: the strongly represented middle age groups also show the highest accident involvement.

Principal causers (n = 177,317): among principal causers, a similar pattern is evident, but with age-related differences. The highest absolute values are found in the groups aged 25-30 years (around 15,800), 21-25 years (around 15,500) and 75 years and older (around 16,500). While the share of principal causers in relation to involvement is moderate in the middle age groups, the relative share is higher among very young and very old drivers. Particularly in the 75+ group, a comparatively high share of principal causers is visible despite lower involvement numbers.

In summary, the greatest absolute accident involvement is in the middle age groups (25-60 years). Young adults (18-30 years) also show high involvement and causation numbers. Among very old drivers (75+), the absolute number is lower, but the share of principal causers is comparatively high. The data evaluated are purely descriptive and, without reference to mileage or population share, do not allow any statement about the individual accident risk of individual age groups.

Figure 25: Descriptive analysis – passenger-car drivers involved in injury accidents in 2024 by driver age (source: based on DESTATIS, 2025, Table UJ 8)



3.7.3 Technical defects in passenger cars as an accident cause

Accidents involving personal injury: the evaluation (DESTATIS, 2025, Table UJ 13b) of technical accident causes for passenger cars shows that in 2024 a total of 1,444 technical or maintenance-related defects were recorded for passenger cars involved in accidents with personal injury. The causes are distributed as follows: tyres 608 cases (approximately 42%); other technical defects 323 cases (approximately 22%); steering 231 cases (approximately 16%); brakes 224 cases (approximately 16%); towing device 30 cases (approximately 2%); lighting 28 cases (approximately 2%).

Defects in tyres, steering and brakes therefore have the greatest significance among technically caused accident causes. Together, these three categories account for around three quarters of all recorded technical defects in passenger cars. In 2024, a total of 1,445 technical or maintenance-related defects were recorded as accident causes among passenger-car principal causers of injury accidents. Relative to the total of 177,317 passenger-car principal causers, this corresponds to a share of around 0.8%.

Fatal accidents: in accidents involving fatalities, a total of 18 technical or maintenance-related defects in passenger cars were recorded. These were distributed as follows: tyres 9 cases (50%); brakes 4 cases (22%); other technical defects 3 cases (17%); steering 2 cases (11%); lighting 0 cases; towing device 0 cases. Thus, even in fatal accidents, defects in safety-relevant vehicle components, especially tyres and brakes, dominate.

Overall assessment: the Destatis data show that technical or maintenance-related defects in passenger cars are documented less frequently as accident causes in police-recorded accident occurrence. Within technically caused accident causes, however, classic safety-relevant vehicle components such as tyres, brakes and steering dominate. The official statistics record only those technical defects that were identified as accident-causing in the course of police accident recording.

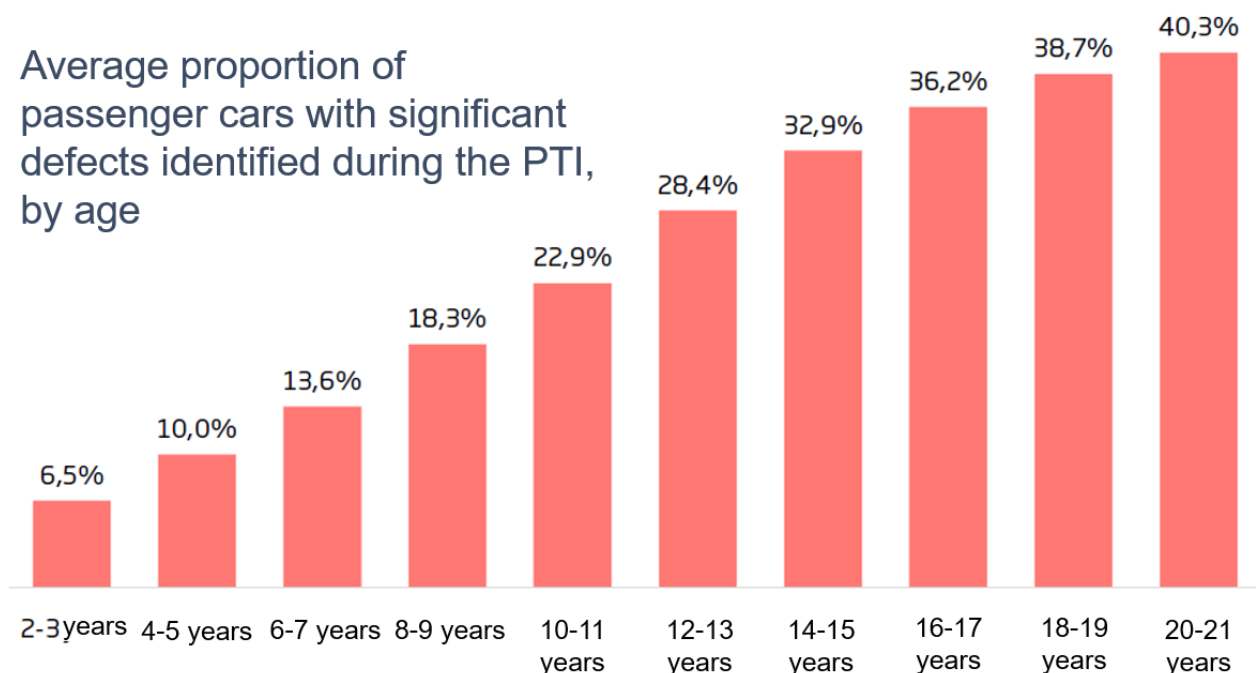
3.7.4 Development of the defect rate of passenger cars at PTI depending on vehicle age (TÜV Report 2026)

The evaluation shows a clear and continuous increase in the share of passenger cars with major or dangerous defects at the periodic technical inspection depending on vehicle age. For passenger cars aged 2-3 years, the defect rate is 6.5%. At 4-5 years it already rises to 10.0%, and at 6-7 years to 13.6%. From an age of 8-9 years, 18.3% of vehicles are already objected to for major defects. From around 10-11 years, the defect rate exceeds 22.9%; at 12-13 years it is 28.4%. In higher age classes, this increase continues: 14-15 years: 32.9%; 16-17 years: 36.2%; 18-19 years: 38.7%; 20-21 years: 40.3%.

Thus, already every fourth passenger car from an age of around 12 years has major defects, while around 40% of vehicles older than 20 years are affected. The data illustrate

an almost linear age-dependent increase in the defect rate across the entire age range considered.

Figure 26: Descriptive analysis – share of passenger cars with major defects at PTI by vehicle age (source: TÜV Report 2026)



source_: TÜV Report 2026, significant and dangerous defects

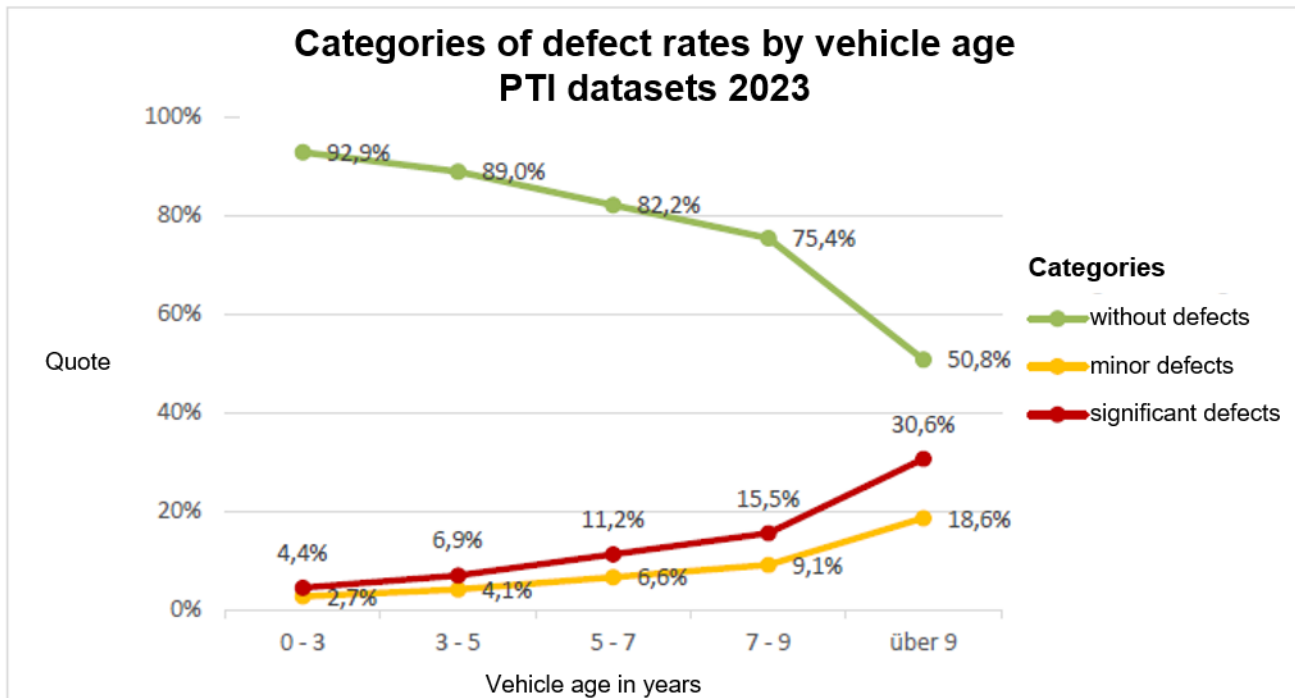
3.7.5 Analysis of defect rates of category M1 vehicles by vehicle age in the context of possible PTI interval extensions

The FSD evaluation [Q43] is based on more than 22 million PTI data records from 2023 for passenger cars in Germany and enables a differentiated consideration of the defect structure by vehicle age. The results show a clear age-dependent increase in defect rates. While only 4.4% of vehicles aged 0-3 years had major defects, this share rises to 6.9% for vehicles aged 3-5 years. Among vehicles aged 5-7 years, the rate of major defects is already 11.2%, and thus 1.6 times as high as in the 3-5-year age class.

In the group of vehicles aged 7-9 years, the share of major defects is already 15.5%. Among vehicles older than nine years, the rate finally reaches 30.6%, meaning that almost every third vehicle has major defects. In parallel, the share of vehicles without defects falls significantly from 92.9% (0-3 years) to 50.8% (over 9 years). In addition, as vehicle age increases, the average number of major or safety-relevant defects per vehicle also rises. Thus, not only the probability of a defect deteriorates, but also its intensity.

Overall, the available data tend to argue against a general extension of PTI intervals for passenger cars, particularly at higher vehicle ages.

Figure 27: Descriptive analysis – defect rates by vehicle age 2023 (source: FSD, 2024 [Q43])



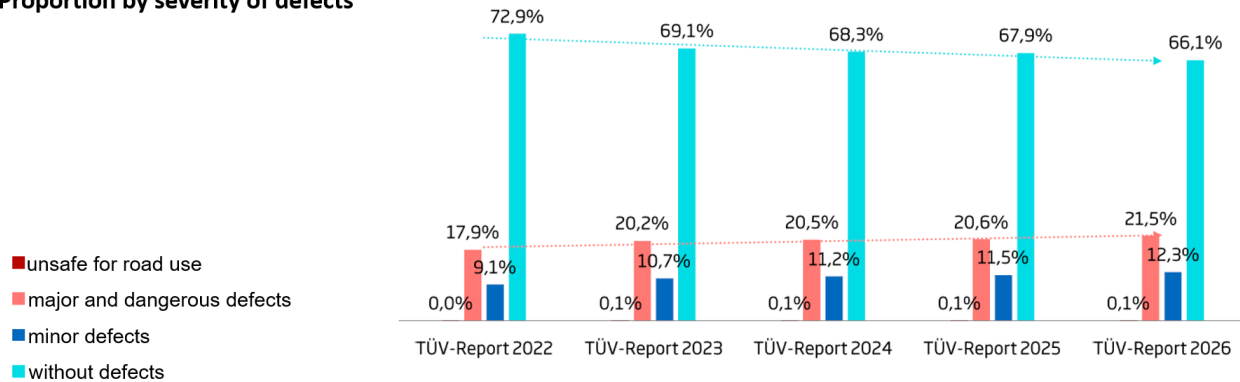
3.7.6 Development of PTI results – comparison of TÜV Report and KBA

The evaluations of the TÜV Report (2022-2026) and the KBA statistics (2014-2023) show different tendencies at first glance, but can be reconciled when viewed in a differentiated manner.

Results according to the TÜV Report (2022-2026): for the most recent reporting years, the TÜV Report shows a declining share of vehicles without defects: 2022: 72.9% without defects; 2023: 69.1%; 2024: 68.3%; 2025: 67.9%; 2026: 66.1%. In parallel, the share of major defects, including dangerous defects, rises from 17.9% in 2022 to 21.5% in 2026. The rate of minor defects also increases moderately, from 9.1% to 12.3%. Unroadworthy vehicles remain at a low level of around 0.1%. The TÜV evaluation therefore shows a deterioration in the defect structure over the last four years.

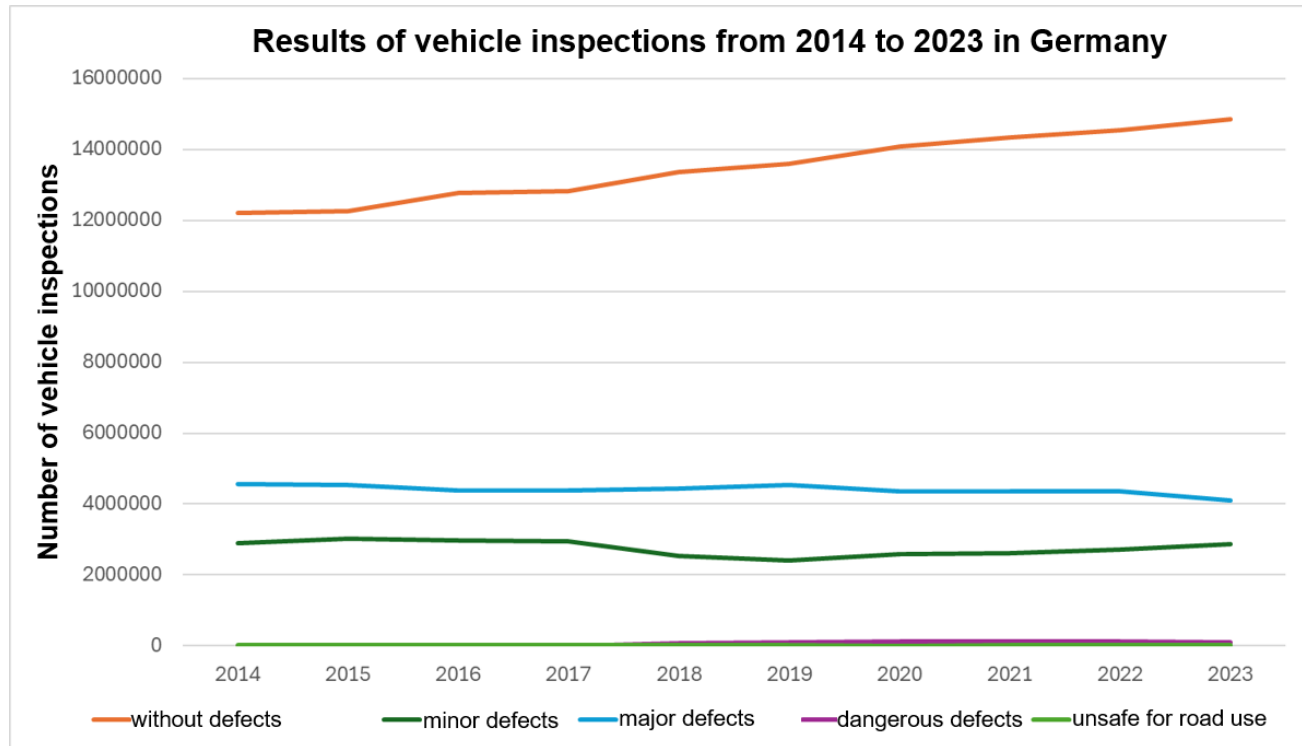
Figure 28: Descriptive analysis – share of defect severity from 2022 to 2026 (source: TÜV Report 2026)

Proportion by severity of defects



Results according to KBA (2014-2023): the KBA time series shows a long-term improvement in the share of vehicles without defects: around 55% without identified defects in 2014 and around 66-68% without defects in 2023/2024. This corresponds to a relative increase of around +20% compared with 2014. At the same time, the absolute number of PTI inspections has increased significantly, from around 12 million to almost 15 million. Despite relative improvements, the absolute number of major defects remains high.

Figure 29: Descriptive analysis – results of vehicle inspections from 2014 to 2023 in Germany (source: KBA)



The differences between TÜV and KBA are essentially based on three factors: different periods, different data bases and structural fleet change. KBA provides a long-term view from 2014 to 2023 and shows a clear improvement. The TÜV Report provides a short-term view from 2022 to 2026 and shows a slight deterioration. KBA covers the entirety of all PTI results, while the TÜV Report is a specific evaluation of vehicles inspected by TÜV inspection organisations. Finally, the vehicle fleet is growing and ageing. As a result, despite improved inspection technology and safety standards, the absolute number of vehicles with defects is increasing.

In the long term (2014-2023), a structural improvement in PTI results is evident, with a marked increase in vehicles without defects. In the short term (since 2022), however, an opposite trend is apparent: the share of vehicles without defects is again falling slightly, while major defects are increasing. This suggests that the technical quality of the vehicle fleet is not improving linearly, but is increasingly influenced by the ageing process of the fleet. With a growing and ageing vehicle fleet, the absolute defect burden in traffic remains high, even if the relative rate of vehicles without defects has increased over longer periods. The findings are therefore not contradictory; rather, they depend on the time horizon considered.

3.8 Conclusion on the vehicle-fleet analysis

The analysis of accessible data sources provides a solid factual basis for assessing relationships between vehicle age, technical condition, usage patterns and accident occurrence. The statistics considered show clear developments in age structure, defect rates and accident involvement, but they do not prove a direct causal relationship between inspection frequency, technical condition and accident prevention. Methodological limitations, such as the point-in-time recording of the technical condition during PTI and the limited recording of technical defects as accident causes, restrict the evidential value regarding the effectiveness of individual measures.

At the same time, the data show that the German passenger-car fleet is ageing and that defect rates increase significantly with vehicle age. Older vehicles are used less intensively on average than younger vehicles, but they more frequently show technical defects and are affected by changing maintenance and repair structures. The descriptive findings therefore underline the relevance of a technically robust and age-sensitive vehicle monitoring system without, on their own, conclusively determining the specific design of inspection intervals.

4 Field sample on the condition of vehicles in traffic

It is generally known that vehicles are specifically serviced and repaired before an upcoming periodic technical inspection. As a result, the actual condition of a vehicle in everyday traffic often differs substantially from its condition when it is first presented for PTI at the inspection organisation. In order to determine the condition of vehicles in normal road traffic, this study used a statistically robust field sample in which officially recognised experts and inspection engineers examined the technical condition of more than 10,000 category M1 vehicles (passenger cars) immediately before maintenance or repair in connection with the upcoming PTI, according to precise specifications. The objective was to determine the extent to which maintenance and repair work is carried out in connection with the PTI.

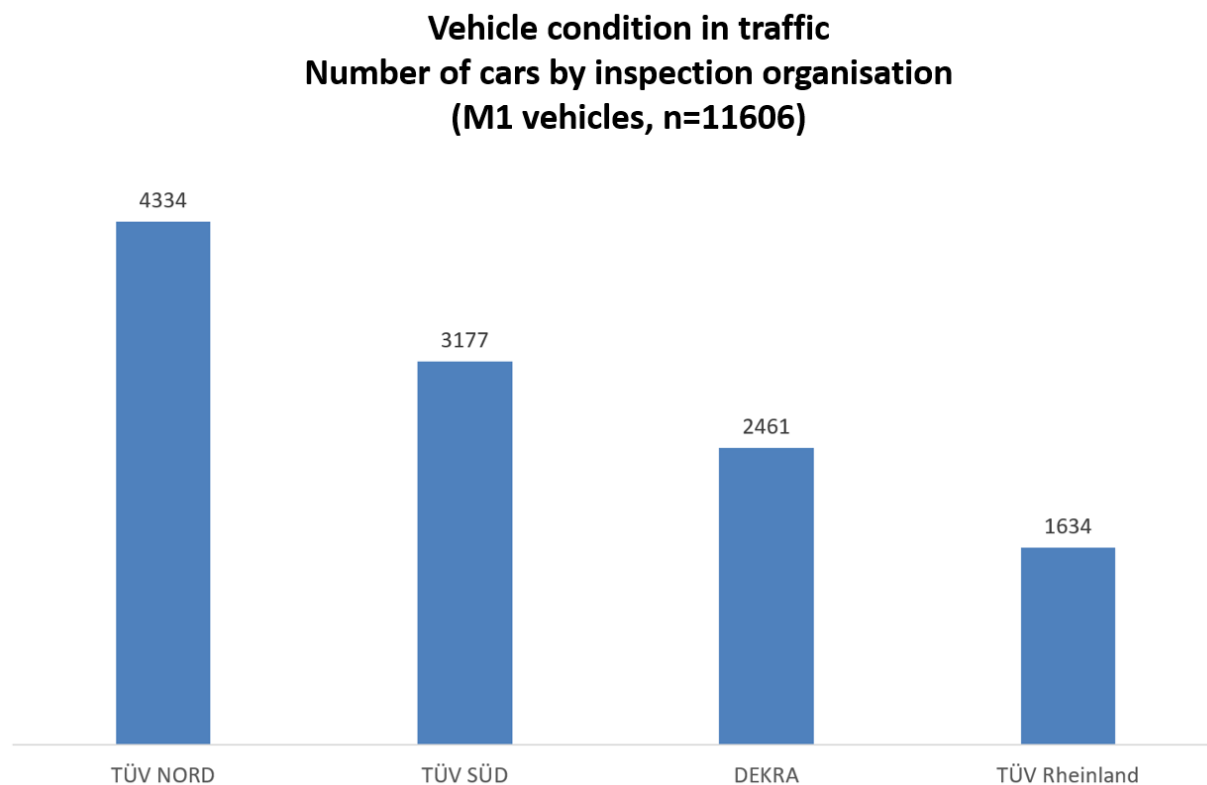
The inspections took place exclusively at inspection support points. These are motor-vehicle workshops where PTIs are performed by officially recognised experts or inspection engineers. The vehicle presented to the expert or inspection engineer for PTI was examined before any necessary repair. If the necessary repairs had already been carried out, they were reconstructed on the basis of the replaced components or repair evidence. If repairs and maintenance were carried out by a workshop other than the motor-vehicle workshop at the inspection support point, the corresponding inferred defects could not be recorded; this leads to an underrepresentation of the actual technical defects in traffic.

The defects identified by the officially recognised experts and inspection engineers in the targeted sample were documented in the same system that they also use for PTI and were made available to HTW Dresden in a separate dataset for further evaluation. Within the framework of this study, the inspection organisations TÜV SÜD, TÜV NORD, TÜV Rheinland and DEKRA were commissioned to carry out the targeted field-sample inspections.

4.1 Descriptive dataset description

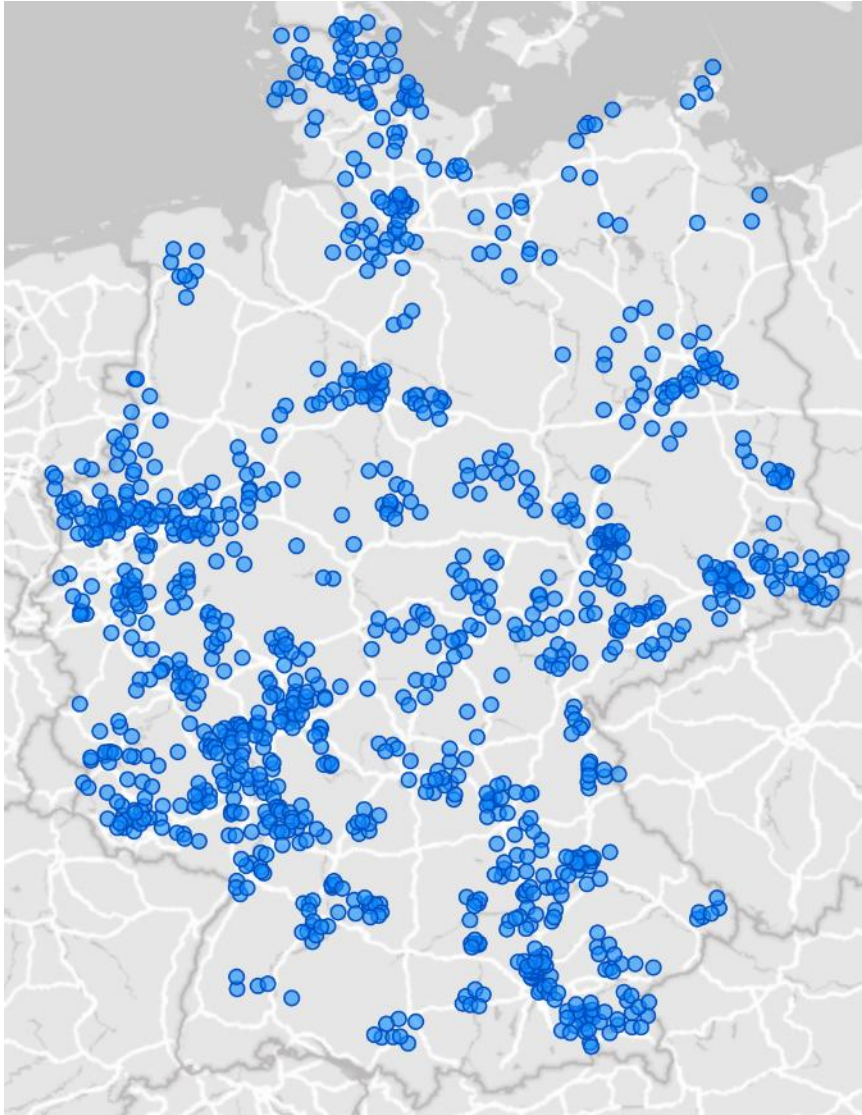
To provide results that are as representative as possible for Germany, the instruction was that every third passenger car presented to an expert or inspection engineer for PTI should be examined, irrespective of whether it appeared conspicuous. This ensured that the selection of the examined vehicles was not biased and corresponded to a representative cross-section of the vehicle fleet.

Figure 30: Vehicle condition in traffic - number and distribution of passenger cars inspected



In total, 11,606 passenger cars were examined as part of the targeted field sample by the inspection organisations TÜV NORD, TÜV SÜD, TÜV Rheinland and DEKRA. These inspections were carried out between August and December 2025.

Figure 31: Vehicle condition in traffic - distribution of inspection support points in Germany

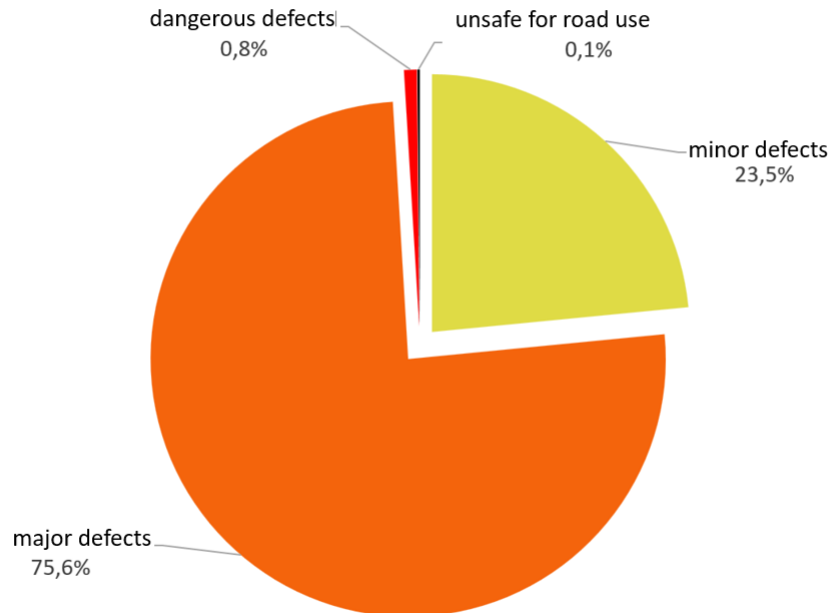


The participation of the inspection organisations enabled a nationwide distribution of the inspections across Germany. No regional anomalies in the composition of the sample were identified.

More than 24,000 defects were identified in passenger cars. These included both defects that had already been remedied by repair and maintenance in connection with the PTI and defects that still existed when the vehicle was first presented for PTI. Figure 32 shows the distribution of defects by defect class.

Figure 32: Vehicle condition in traffic - number of identified defects by defect class

Vehicle condition in traffic Number of defects by defect classes (M1 vehicles, n=24535)

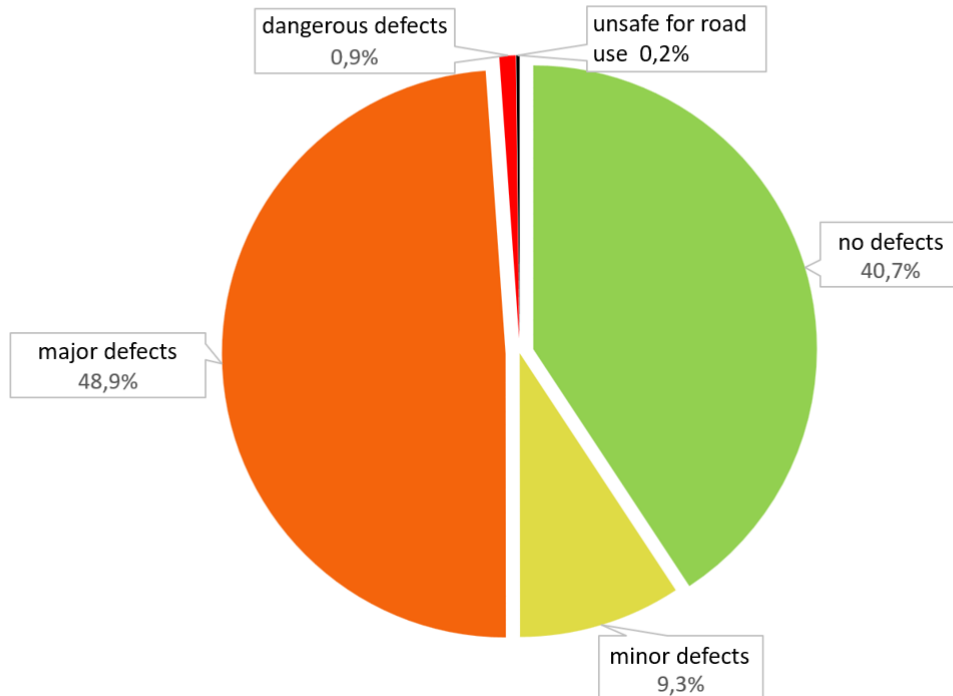


Around one quarter of the identified defects were minor defects, while approximately three quarters were classified as major defects. Dangerous defects and defects rendering the vehicle unsafe to operate together accounted for only around one percent of all identified defects.

Figure 33 shows the analysis of the inspected vehicles according to the respective inspection result.

Figure 33: Vehicle condition in traffic - distribution of passenger cars by inspection result

Vehicle condition in traffic Shares of inspected cars by defect classes (M1 vehicles, n=24535)

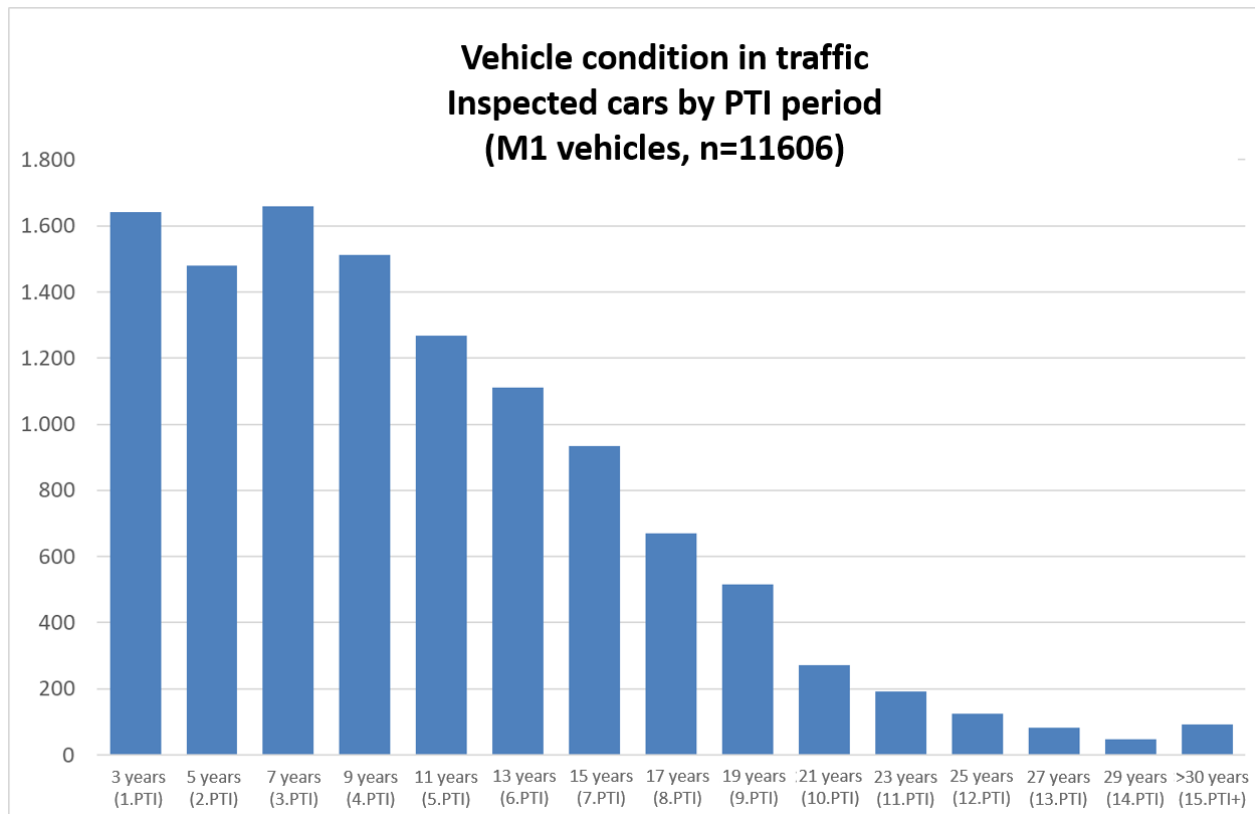


Overall, 40.7% of all passenger cars had no defects before maintenance and repair in connection with the PTI or at the time of the PTI. In 9.3% of the inspected passenger cars, only minor defects were identified. Averaged across vehicle age, exactly 50% of passenger cars in traffic would therefore have received a PTI sticker. The predominant share of vehicles that would not have been granted a sticker had major defects. The share of vehicles with dangerous defects or defects rendering them unsafe to operate was around 1.1%.

It should be noted that, by nature, the vehicle population decreases as vehicle age increases. For this reason, the group size of the inspected passenger cars also decreased in relation to the respective PTI periods. From the eleventh PTI onward, all further vehicles were assigned to the group "11th PTI+". Under strict application of the current German PTI interval scheme of 3/2/2, this corresponds to vehicles aged at least 23 years.

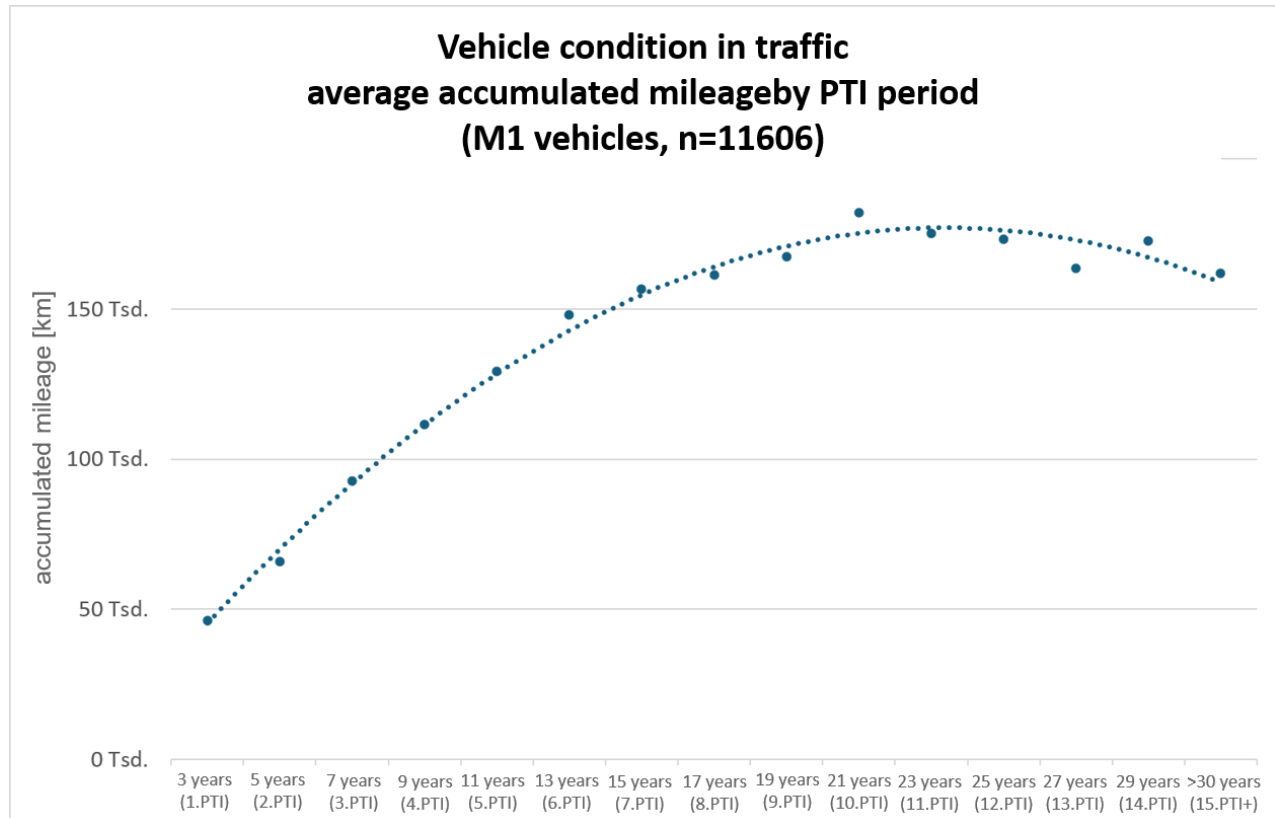
For all inspected passenger cars, information was available on the date of first registration and the time remaining until the next PTI, allowing the respective PTI period to be narrowed down relatively precisely. Vehicles that in the past had undergone PTI considerably after the due date or substantially earlier than scheduled may deviate from the specific PTI period; however, this is irrelevant for the analysis of defect frequency in road traffic.

Figure 34: Vehicle condition in traffic - number of passenger cars by PTI period



The distribution of passenger-car age groups in Figure 34 corresponds, as expected, to the current passenger-car fleet in Germany.

Figure 35: Vehicle condition in traffic - average mileage by PTI period



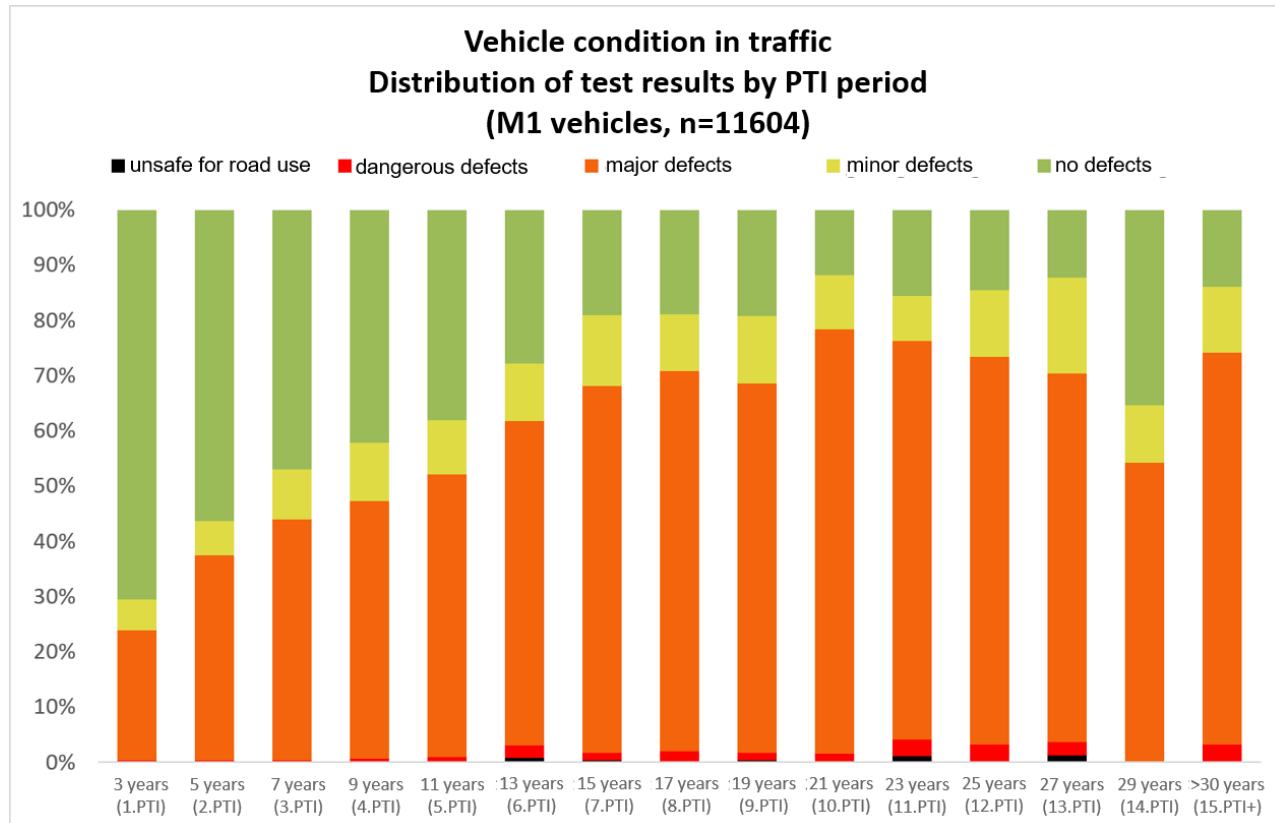
As vehicle age increases, average accumulated mileage rises and reaches its maximum at approximately 23 years. The decline in mileage from an age of 25 years onward can be explained by the remaining vehicles then increasingly being enthusiast vehicles and classic cars.

4.2 Inspection results

All subsequent analyses in this study are carried out exclusively at vehicle level. The results therefore describe correlations with the PTI inspection result, not with the total number of defects identified during the inspection. Thus, passenger cars with the PTI result "major defects" do not have defects rendering them unsafe to operate or dangerous defects, but they do have at least one major defect. Further minor or major defects may nevertheless also be present in these vehicles.

Figure 36 shows the distribution of inspection results by vehicle age, expressed as PTI period.

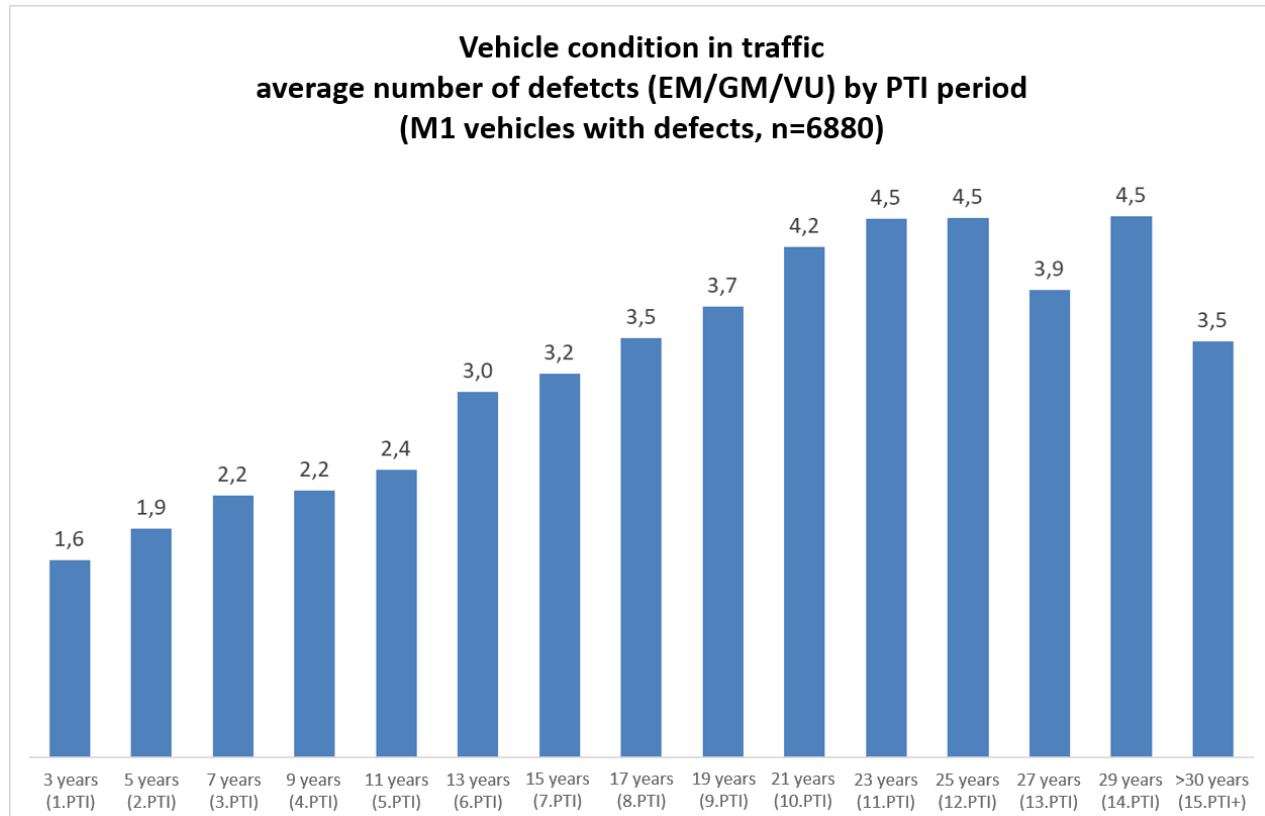
Figure 36: Vehicle condition in traffic - distribution of passenger cars by inspection result and PTI period



The share of passenger cars in traffic with major or dangerous defects or which are unsafe to operate increases with vehicle age to almost 80% by the 10th PTI. Accordingly, the repair and maintenance effort in connection with the upcoming PTI also increases with vehicle age. This explains the rising share of passenger cars that are finally withdrawn from service between the ages of 12 and 24 years.

For all 6,680 passenger cars with PTI inspection results of major, dangerous or unsafe-to-operate defects, Figure 37 shows the average number of major, dangerous and unsafe-to-operate defects per vehicle.

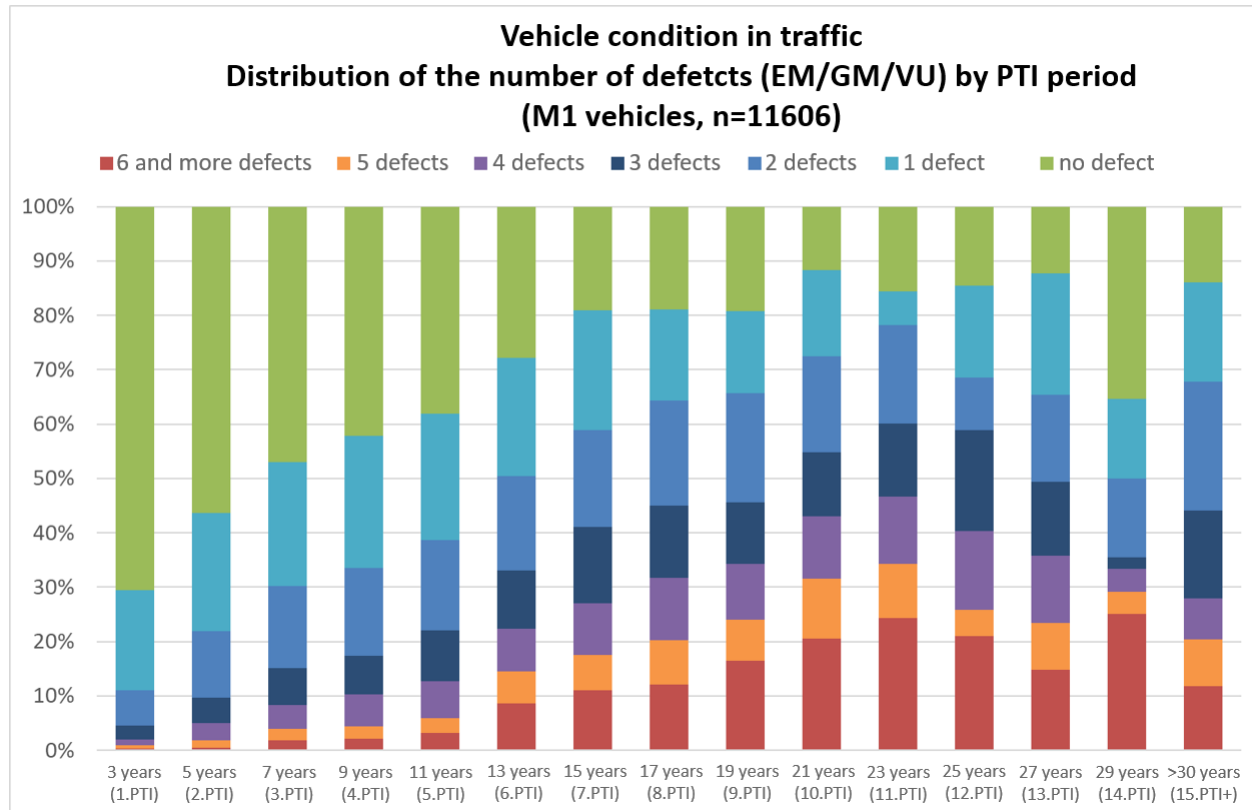
Figure 37: Vehicle condition in traffic - average number of defects in defective passenger cars by PTI period



As vehicle age increases, the average number of identified defects (major, dangerous and unsafe-to-operate defects) rises, and with it the repair and maintenance effort before the PTI. While an average of 1.6 defects per passenger car must be remedied before the first PTI, the corresponding figure before the tenth PTI is already 4.2 defects. The higher effort and the lower market value of older vehicles often lead to final deregistration or export abroad. The tendency for the average number of defects to decline from an age of 25 years onward can again be explained by the increasing share of enthusiast vehicles.

This trend is also visible in the distribution of the number of defects by PTI period shown in Figure 38.

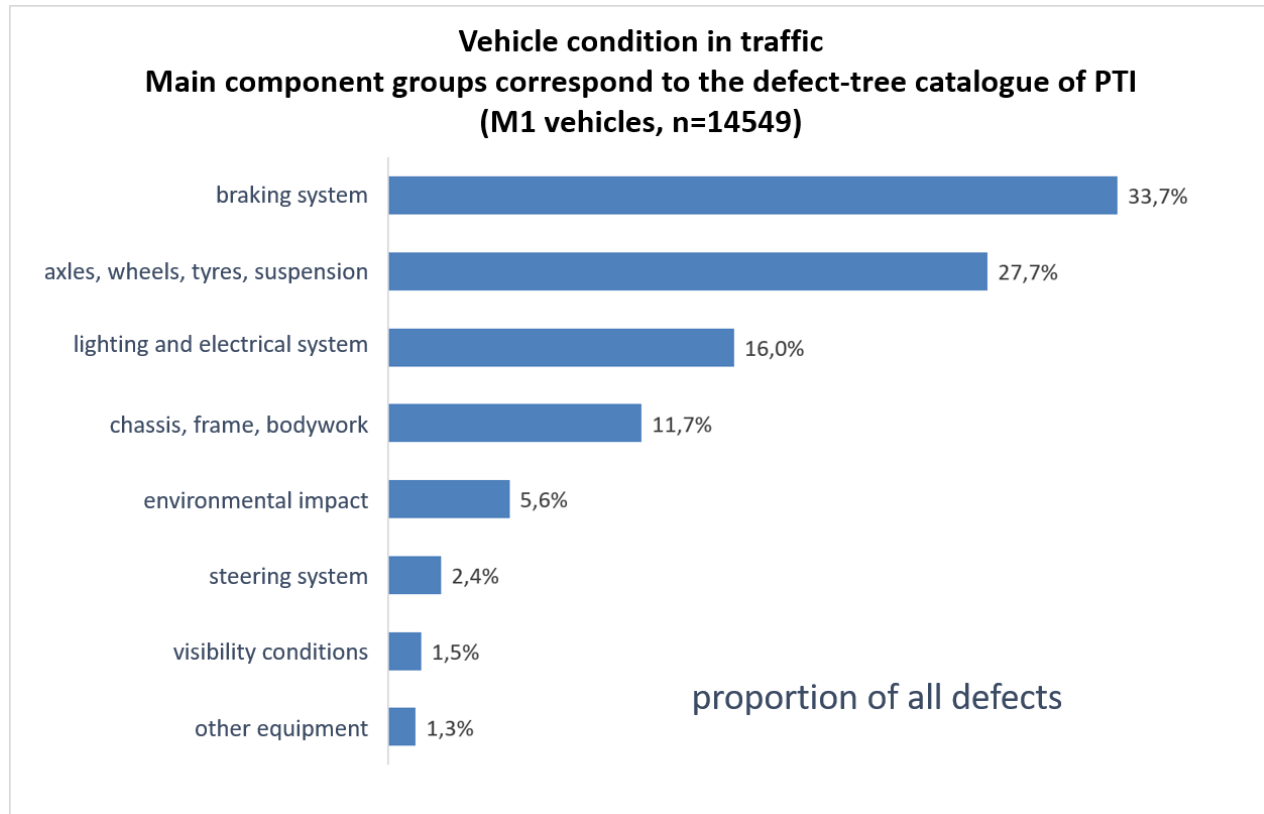
Figure 38: Vehicle condition in traffic - distribution of the number of defects in passenger cars by PTI period



As vehicle age progresses, the share of inspected passenger cars with a larger number of defects increases significantly. This results in a correspondingly higher need for repair and maintenance in connection with the upcoming PTI.

The following Figure 39 shows the distribution of identified defects by the main component groups from the defect-tree catalogue.

Figure 39: Vehicle condition in traffic - defects (major/dangerous/unsafe) by main component groups



4.3 Conclusion on the field sample concerning vehicle condition in traffic

The investigation shows that the actual condition of passenger cars in road traffic can differ significantly from their condition when presented for PTI, because many vehicles are serviced and repaired specifically in connection with the PTI. The analysis of more than 11,000 vehicles at inspection support points found that only around half of the vehicles in traffic are free of defects and would receive a PTI sticker. As vehicle age increases, both the number and the severity of defects increase markedly. In particular, in the tenth PTI period, up to 80% of vehicles have major or dangerous defects or are unsafe to operate.

The repair and maintenance effort before the PTI increases with vehicle age. This contributes to older vehicles being finally withdrawn from service or exported more frequently. The findings underline that the PTI has a strong anticipatory effect: it triggers maintenance and repair measures that are not visible in the official PTI result alone. For the further analyses in this study, the field sample therefore provides an essential empirical basis for modelling defect probabilities by vehicle age and for assessing potential effects of changed inspection intervals.

5 Analysis of vehicle condition in accident occurrence

In this part of the study, the technical condition of vehicles involved in accidents was analysed. The starting point is the question of the extent to which road accidents can be attributed to technical defects or at least stand in a comprehensible relationship with such defects. This perspective is central to the further analysis, because only that share of accident occurrence which can in fact be influenced by an improved technical condition of the vehicle fleet represents a realistic reduction potential.

The following evaluations therefore serve to narrow down this potential more precisely and subsequently make it usable for estimating possible effects of a reduction in technical defects in traffic. A central basis is the age dependence of technical defects demonstrated in Chapter 4. As vehicle age increases, the share of vehicles with technical defects rises; this relationship is also visible in accident occurrence.

5.1 Official road-accident statistics

For a qualified assessment of the significance of technical defects in accident occurrence, a dataset would in principle be required that systematically records relevant technical vehicle parameters and thus enables a differentiated assessment of their relevance to the accident. However, the official road-accident statistics capture technical defects only to a limited extent, since they are essentially based on defects and externally visible characteristics recognised by police officers during accident recording.

Accordingly, the share of technical defects reported as an accident cause in the official statistics is low, at around 0.8%. It must therefore be assumed that technical defects and maintenance defects as accident causes are systematically under-recorded in the official accident statistics. This hidden share could only be reduced if accident vehicles were regularly subjected to an in-depth technical inspection. In view of the practical circumstances faced by police officers at the accident scene and the very different scope and severity of accidents and damage, however, this would not be proportionate.

5.2 DEKRA accident database - accident-relevant technical defects

DEKRA carries out road-accident reconstructions throughout Germany, offered at most branches with a 24/7/365 on-call service. This on-call service enables experts to reach the accident scene as quickly as possible for accident recording and evidence preservation together with the police. Such accident-analysis assessments are commissioned, for example, whenever the public prosecutor initiates proceedings on the initial suspicion of misconduct by an accused person. This is almost always the case in accidents in which an accident participant has been fatally or life-threateningly injured and the accident is not a single-vehicle accident.

Courts and public prosecutors commission a technical vehicle inspection as part of accident-analysis assessment on the principle that a possible accident-relevant technical defect must be either included or excluded, irrespective of whether such a defect is suspected. If the experts are called directly to the accident scene, all vehicles involved are examined to determine whether there is an initial suspicion of technical defects that may have influenced the accident occurrence. This includes, for example, checking the tyres, the plausibility of restraint-system deployment, free movement of the steering, braking function and similar aspects. Depending on the possibilities and controllable aspects at the accident scene, vehicles may also be examined in a workshop. This is also possible in file-based reconstructions if the vehicles are still available.

The present dataset is subject to several structural and substantive limitations that must be taken into account when interpreting the results. One key feature is selective case inclusion: a commission for accident reconstruction or basic evidence preservation is usually issued only for serious road accidents or in cases in which the question of fault cannot be clarified unequivocally by the police officers recording the accident. Minor accidents with limited property damage, such as typical rear-end collisions, are generally not reconstructed, even if technical defects such as worn tyres or reduced braking performance could potentially have been causative.

The database therefore primarily contains information on serious or complex accident occurrence. However, for the accident relevance of an identified technical defect, the severity of the accident as a consequence of causation is not decisive. The frequency and occurrence of an accident-relevant technical defect do not in themselves permit an estimate of the expected accident severity. For example, a broken control arm renders a vehicle incapable of being driven, but does not necessarily lead to an accident of corresponding severity. Conversely, accident-relevant technical defects must be considered independently of the consequences of the accident; therefore, preselecting the examined accidents by accident severity and accident category does not in itself limit the meaningfulness of the analysis.

In the 1970s, DEKRA created its first database for collecting data on technical defects. This database has been continuously developed over time. Since 2014, experts have entered the data digitally themselves after completing the expert report. Data are entered in the database only for vehicles that were examined in detail as part of an accident reconstruction. For this study, only digitally recorded datasets since 2014 were analysed.

The defect assessment in these technical vehicle inspections is not based on PTI categories or formal severity, but exclusively on accident-related relevance. A defect that would be dangerous or render the vehicle unsafe to operate in a PTI may be irrelevant to the accident sequence; conversely, formally minor defects may prove to be accident-

relevant. A technical vehicle inspection after a road accident is therefore not a PTI. Rather, it is a targeted inspection only of those components and assemblies that are relevant to the respective accident sequence. The findings from these datasets should therefore not be understood as a complete defect recording.

Accordingly, the present analysis is not based on the official accident statistics, but on the DEKRA accident database derived from accident-analysis reports prepared by DEKRA experts. The evaluation included only datasets from the complete accident database for which the accident date was known and stated. No further filtering of the complete database was carried out, so the total number of evaluable datasets varies depending on the parameter evaluated. In total, data from 2,429 technical vehicle inspections of accident-involved passenger cars in vehicle category M1 were available for the evaluation.

The technical defects relevant to the accident were distinguished into the following categories:

- causal for the accident;
- contributory cause of the accident;
- possibly causal for the accident;
- without influence on the accident occurrence;
- no defect.

Figures 40 to 49 use real accident reports to provide visual examples of the expert assessment of the respective categories.

Figure 40: Vehicle condition in accident occurrence - example 1 accident sequence, defect category "causal for the accident"

Defect causal for accident Example 1 - Driver fatally injured

Sequence of events

Car **leaves** the roadway to the right **into** the grass verge

Embankment leading to a joining forest road acts as a ramp → car becomes airborne

Collision while airborne with bushes and a group of trees

Final position on passenger side against a tree



¹ DEKRA Accident Research - Technical Defects Database

Figure 41: Vehicle condition in accident occurrence - example 1 accident cause, defect category "causal for the accident"

Defect causal for accident Example 1 - Driver fatally injured

Accident cause

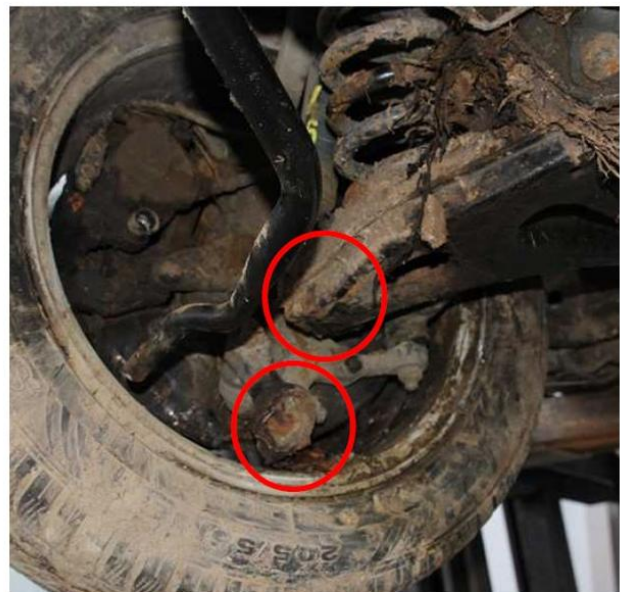
Severe corrosion damage at the weld seam of the right control arm

Material loss led to sudden fracture

Trace evidence confirms: fracture occurred during driving, not as a consequence of the crash



Defect causal for accident



² DEKRA Accident Research - Technical Defects Database

Figure 42: Vehicle condition in accident occurrence - example 2 accident sequence, defect category "causal for the accident"

Defect causal for accident Example 2 - Cyclist seriously injured

Sequence of events

Vehicle turns right

In doing so, crosses left over the oncoming lane
and leaves the roadway

Enters adjacent footpath and collides there with
a waiting cyclist

Driver: brake could not be applied



DEKRA Accident Research - Technical Defects Database

Figure 43: Vehicle condition in accident occurrence - example 2 accident cause, defect category "causal for the accident"

Defect causal for accident Example 2 - Cyclist seriously injured

Accident cause

Fracture of the aged vacuum line of the
brake booster

Brake booster not functioning; braking
effect achievable only with significantly
increased pedal force

Significantly more difficult braking in
the reaction phase



Defect causal for accident

4 DEKRA Accident Research - Technical Defects Database

Figure 44: Vehicle condition in accident occurrence - example 3 accident sequence, defect category "contributory cause"

Defect contributory cause for accident Example 3 – 1 killed, 2 seriously injured

Sequence of events

Car approaches an intersection at excessive speed

Emergency braking initiated because of crossing traffic

Unstable driving state; skidding left off the roadway

Collision with roadside objects

Final position on private property after collision with tree



5 DEKRA Accident Research – Technical Defects Database

Figure 45: Vehicle condition in accident occurrence - example 3 accident cause, defect category "contributory cause"

Defect contributory cause for accident Example 3 – 1 killed, 2 seriously injured

Accident cause:

Technical defects in the brake system (worn rear brake discs) and tires (insufficient tread depth)

This reduced driving-dynamic stability and lengthened braking distances

Speed and driving style not adapted to the traffic situation



**Defect contributory
cause for accident**

6 DEKRA Accident Research – Technical Defects Database

Figure 46: Vehicle condition in accident occurrence - example 4 accident sequence, defect category "contributory cause"

Defect contributory cause for accident Example 4 – Female driver seriously injured



Sequence of events

Car leaves the roadway to the right on a downhill section in a left-hand curve
Drives over adjacent grass area, colliding with a directional sign
Continues down the adjacent embankment
Vehicle rolls over multiple times in the embankment area
Final position approx. 25 m from the roadway, on its roof



7 DEKRA Accident Research – Technical Defects Database

Figure 47: Vehicle condition in accident occurrence - example 4 accident cause, defect category "contributory cause"

Defect contributory cause for accident Example 4 – Female driver seriously injured



Accident cause:

Rear wheel brake components installed left-right reversed in the workshop
This caused failure of the ABS system
Vehicle without additional rear-axle brake-force regulation
Wet roadway and speed not adapted
Warning lights and noise generation not heeded



**Defect contributory
cause for accident**



8 DEKRA Accident Research – Technical Defects Database

Figure 48: Vehicle condition in accident occurrence - example 5 accident sequence, defect category "possibly causal"

Defect possibly causal for the accident Example 5 – 1 killed, 3 seriously injured



Sequence of events

At the exit of a left-hand curve, loss of control over the vehicle

Rear end breaks away and the vehicle enters a skid

Leaves into oncoming traffic and collides with an oncoming car



9 DEKRA Accident Research – Technical Defects Database

Figure 49: Vehicle condition in accident occurrence - example 5 accident cause, defect category "possibly causal"

Defect possibly causal for the accident Example 05 – 1 killed, 3 seriously injured



Accident cause

Accident triggered by inappropriate driving style and speed

Wet roadway

Reduced tire pressure and advanced tire age

Defects, in combination with driving style and road condition, may have favored the accident



**Defect possibly causal
for the accident**

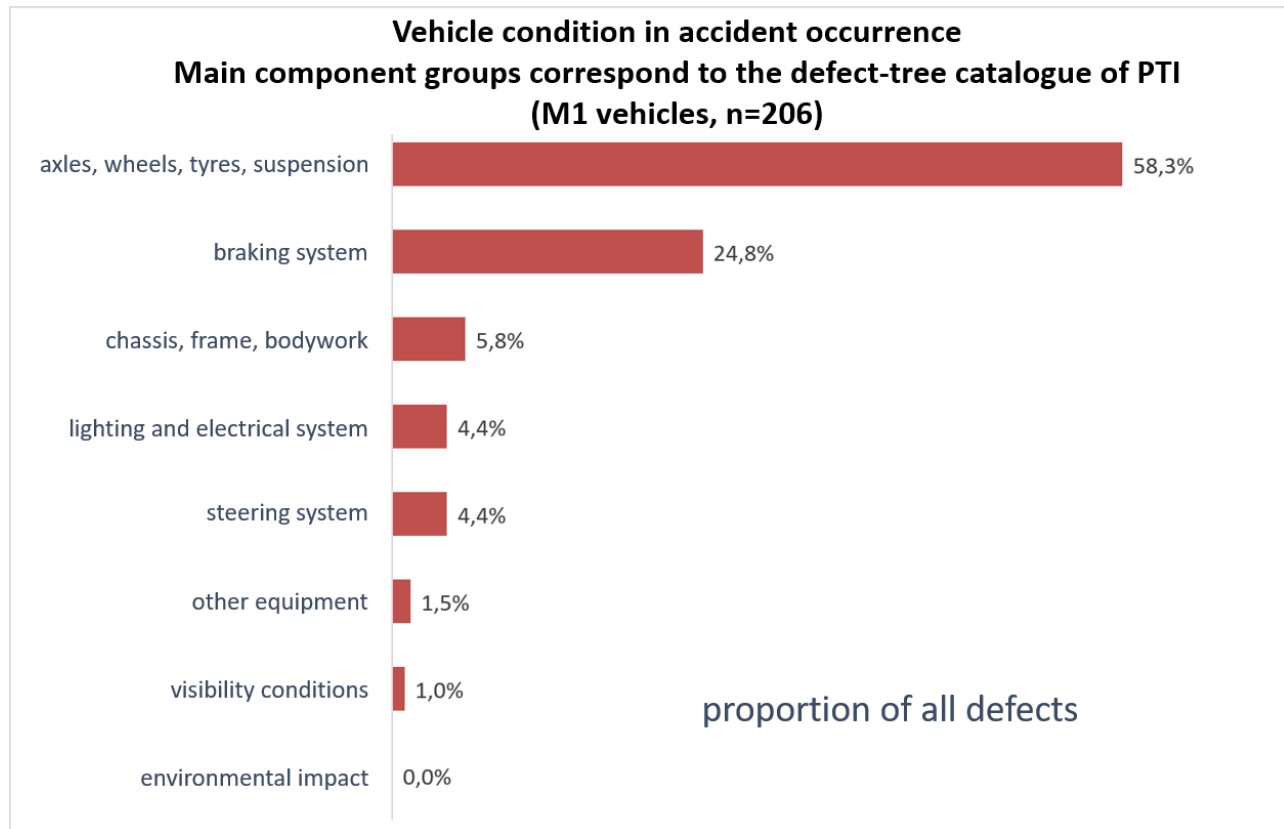
10 DEKRA Accident Research – Technical Defects Database

Categories a to c are summarised in the further analysis as accident-relevant.

Technical inspections of vehicles after road accidents provide a starting point for a meaningful assessment of the share of accident-relevant technical defects in serious road accidents. In contrast to the official accident statistics, these data include not only externally visible indications from police accident recording, but also technical assessments by experts in the context of specific accident analyses and accident sequences.

The distribution of accident-relevant technical defects by main groups is shown in Figure 50.

Figure 50: Vehicle condition in accident occurrence - accident-relevant technical defects by main component groups



For the use of the data obtained through accident analyses in assessing the share of accident-relevant technical defects in accident occurrence, an additional check was carried out to determine the extent to which the dataset is structurally comparable with the dataset of the official road-accident statistics. This classification is provided in the following section.

5.3 Comparison of accident datasets

To classify the transferability of the data collected by DEKRA accident analysts, the structure of the examined datasets was compared with the official accident statistics from Destatis. Three central independent characteristics were taken into account, all of which are available almost completely in both datasets:

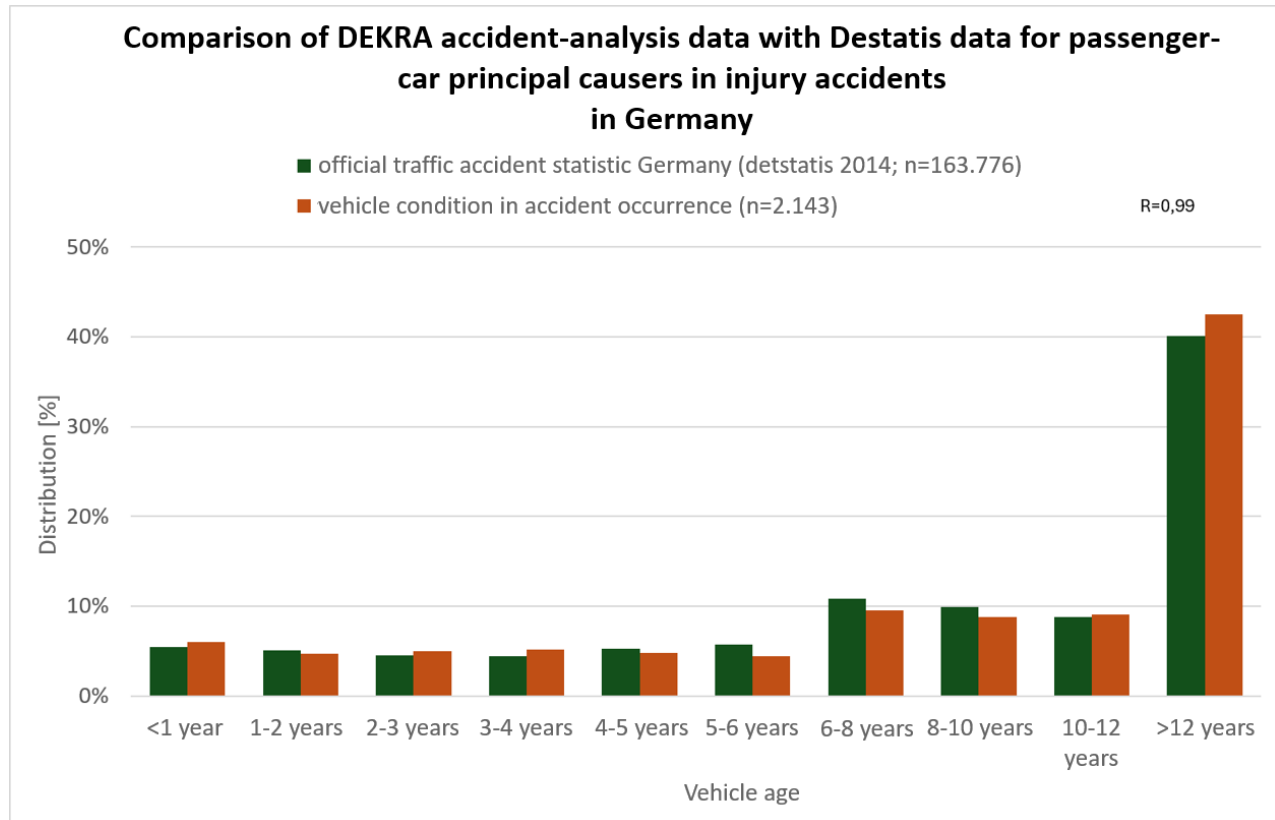
- vehicle age;
- age of the person driving the vehicle;
- sex of the person driving the vehicle.

The comparison in Figures 51, 52 and 53 shows that the examined sample has an almost identical distribution to the official data on principal causers driving passenger cars in accidents involving personal injury with regard to the essential structural characteristics.

Thus, the dataset is not an obviously distorted special sample, but a database whose basic structure is comparable with official accident occurrence.

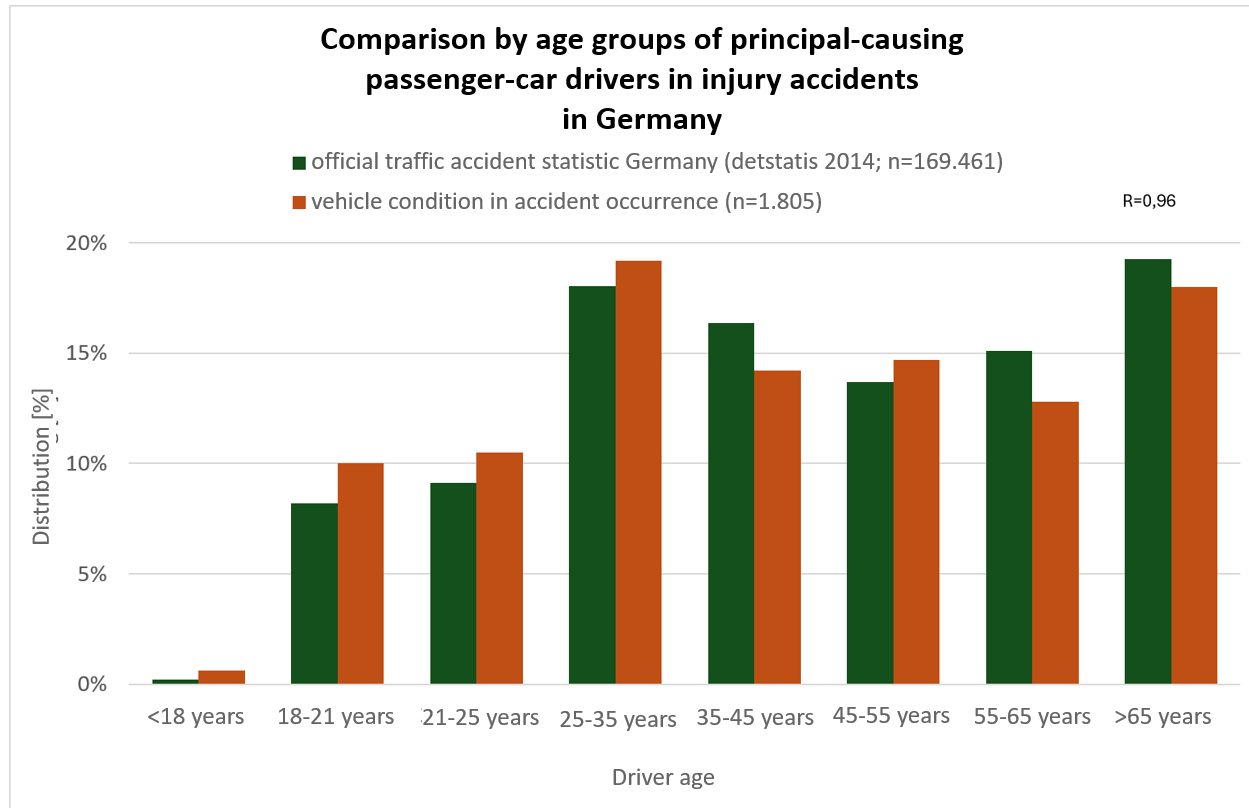
This is particularly clear for vehicle age, see Figure 51. In both datasets, the vehicles are distributed across all age classes in similar proportions. The younger vehicle classes under six years are each in comparable share ranges. A similar pattern also appears for older vehicles: the class "12 years and more" constitutes the largest group both in the DEKRA accident database and in the Destatis statistics. Its share is 42.5% in the DEKRA dataset and 40.1% in the 2024 Destatis data. The age structure of the vehicles is therefore very similar. The correlation coefficient is $R = 0.99$. This is particularly important for the present analysis because the share of technical defects depends strongly on vehicle age. A comparable vehicle-age structure therefore supports the use of the DEKRA datasets as a robust basis for the further calculation.

Figure 51: Vehicle condition in accident occurrence - comparison with official accident statistics by vehicle age



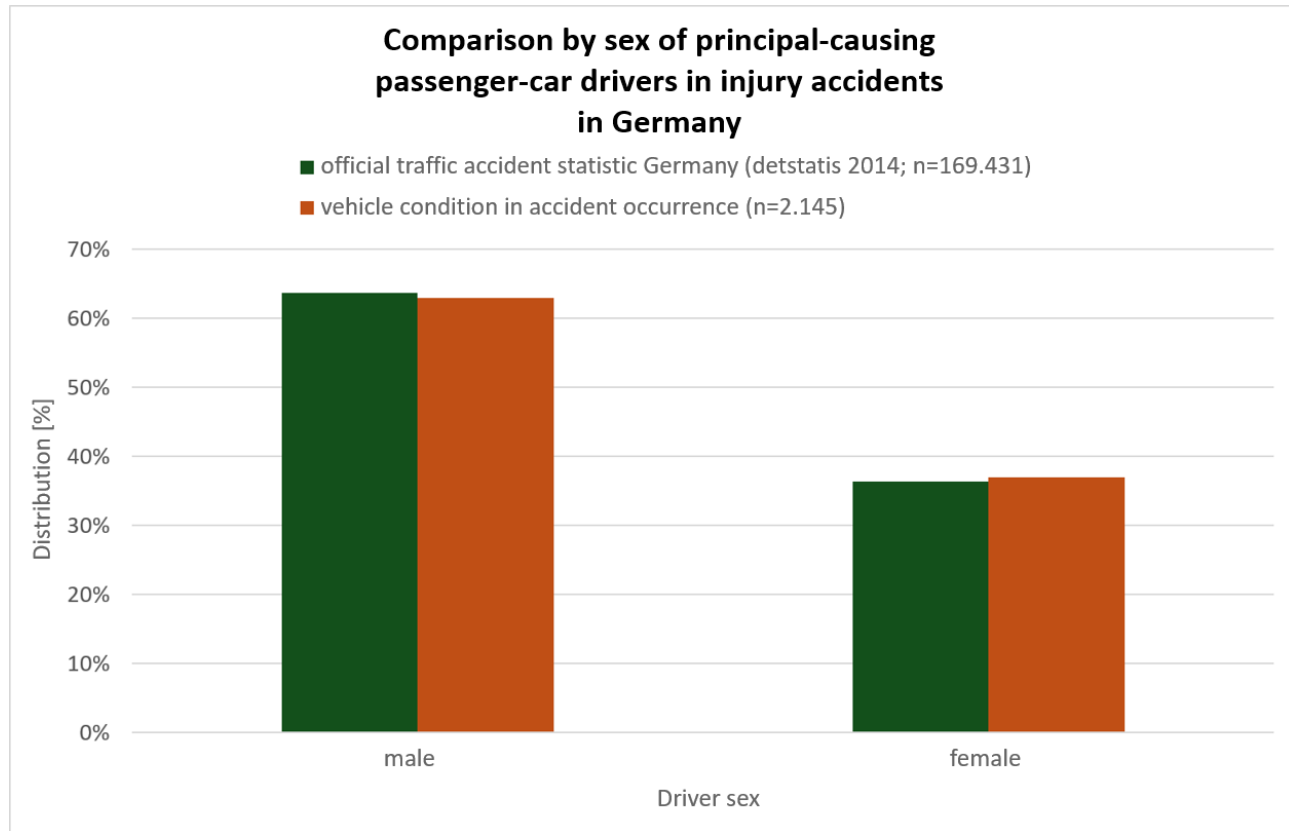
No fundamental structural breaks are evident with regard to the age of the drivers either, see Figure 52. The age groups in both datasets are distributed over a similar spectrum. In the DEKRA data, for example, 19.2% are in the age group 25 to 35 years and 18.0% are persons aged 65 years and over. In the 2024 Destatis data, the corresponding shares are 19.3% and 18.1%, respectively. The middle age groups also mostly fall within comparable magnitudes. The correlation coefficient is $R = 0.96$. Overall, the age structure of the principal-causing passenger-car drivers is very similar, so a fundamentally comparable sample can be assumed.

Figure 52: Vehicle condition in accident occurrence - comparison with official accident statistics by driver age



The distribution by sex of principal-causing passenger-car drivers is almost identical, see Figure 53. In both datasets, men are represented more strongly than women. The male share in the DEKRA dataset, at 64%, is almost the same as the share of male principal-causing passenger-car drivers in accidents involving personal injury in the 2024 Destatis data, where it is 63%. The female share is correspondingly comparable. Here too, a very well comparable sample can be assumed.

Figure 53: Vehicle condition in accident occurrence - comparison with official accident statistics by sex



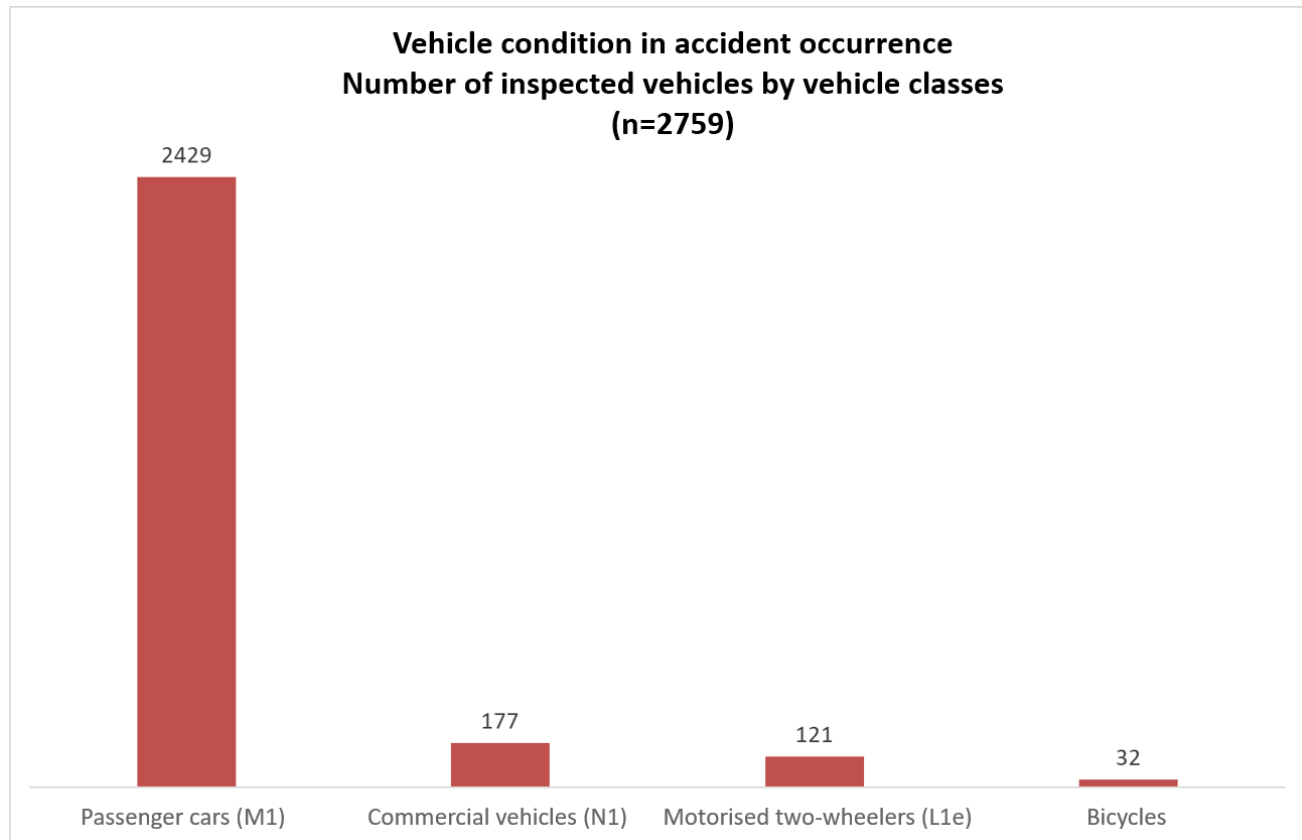
Overall, the comparison shows that the DEKRA accident data do not exhibit any fundamental deviations from the official accident statistics in terms of vehicle age, driver age and driver sex. It should also be noted that comparability was checked here only on the basis of selected structural characteristics. Statements on the representativeness of the dataset for overall official accident occurrence are therefore possible only to a limited extent. In particular, the special composition of the DEKRA data, which are predominantly based on accident-analysis expert reports on more serious or more deeply investigated accident events, may be associated with systematic bias. This can neither be conclusively confirmed nor refuted with the available data. For the further analysis, this means that the data are meaningful for the research question of this study. The observed structural proximity in the characteristics considered supports their use as a professionally plausible basis for further estimating the potential of accident-relevant technical defects.

5.4 Descriptive statistics of the accident data

In total, 2,759 accident analyses were evaluated with regard to the results of the technical vehicle inspections, including 2,429 technical inspections of passenger cars in category M1. For the evaluation, vehicle data such as first registration, accident date, vehicle category

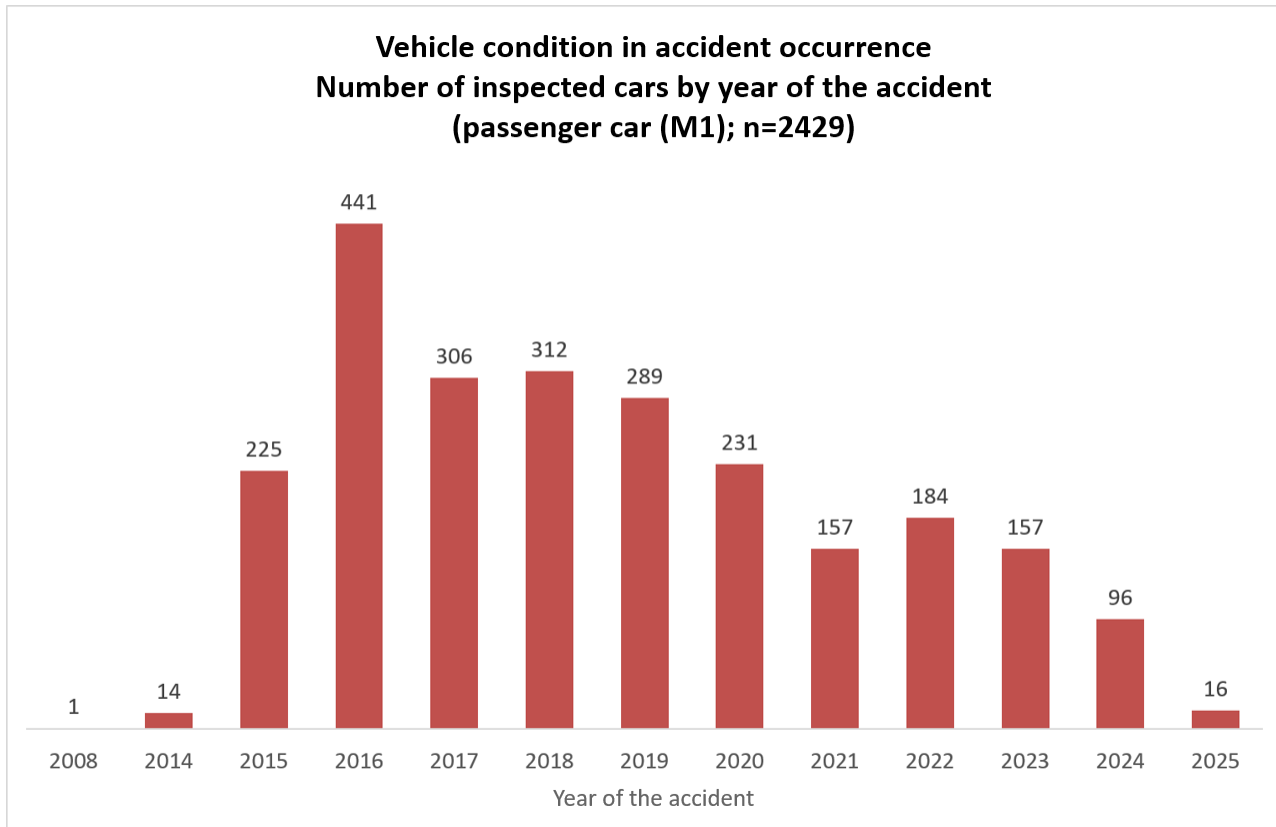
and date of the last PTI were collected. The breakdown of vehicles by vehicle category is shown in Figure 54.

Figure 54: Vehicle condition in accident occurrence - examined vehicle categories



The number of technical inspections of category N1 vehicles, L1e vehicles and bicycles was so small that the data basis was not pursued for further investigations within this study. The subsequent analyses therefore evaluate only vehicle category M1 (passenger cars). The corresponding vehicles, broken down by accident year, are shown in Figure 55.

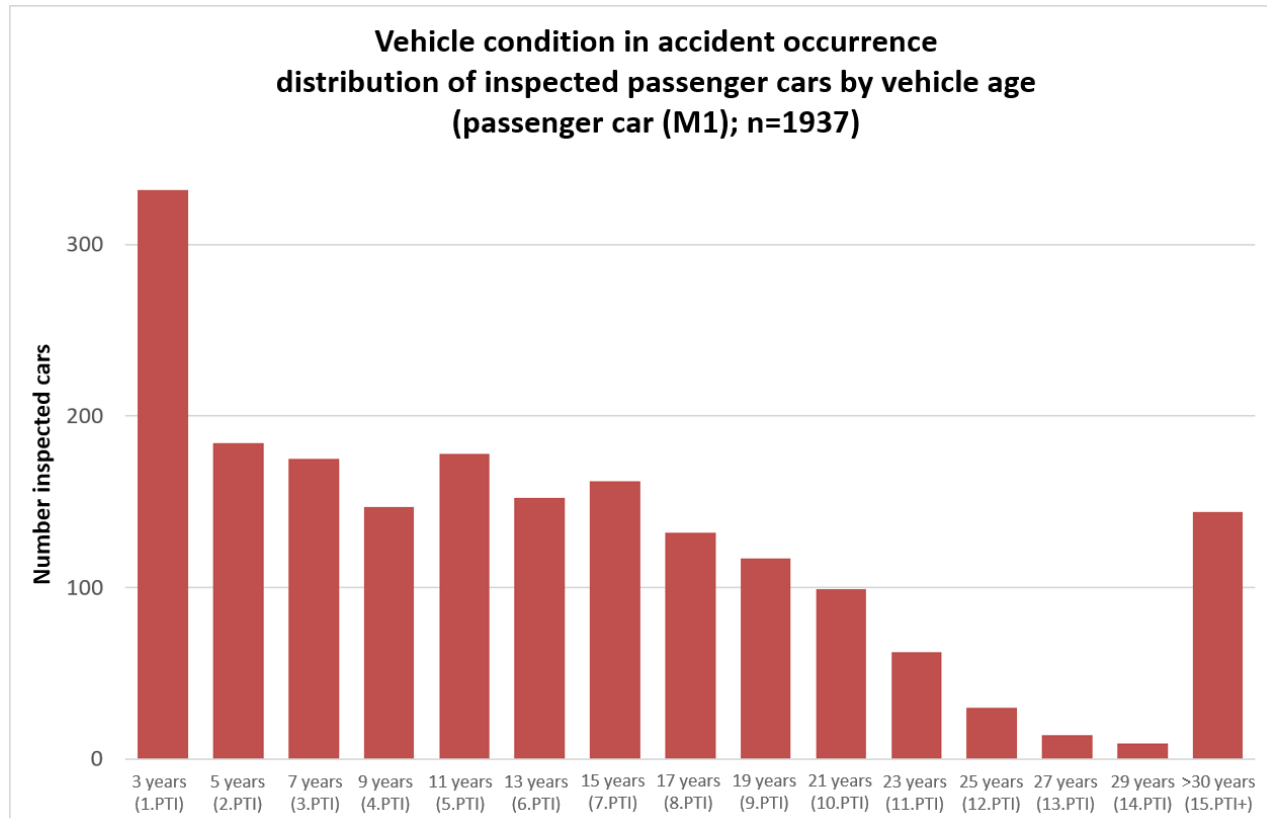
Figure 55: Vehicle condition in accident occurrence - distribution of examined passenger cars by accident year



The examined passenger cars were predominantly involved in serious accidents involving personal injury that occurred within the past ten years. The data basis can therefore be considered current.

For the analysis by vehicle age, only 1,937 examined passenger cars in category M1 could be used in Figure 56 because of missing data.

Figure 56: Vehicle condition in accident occurrence - distribution of examined passenger cars by vehicle age

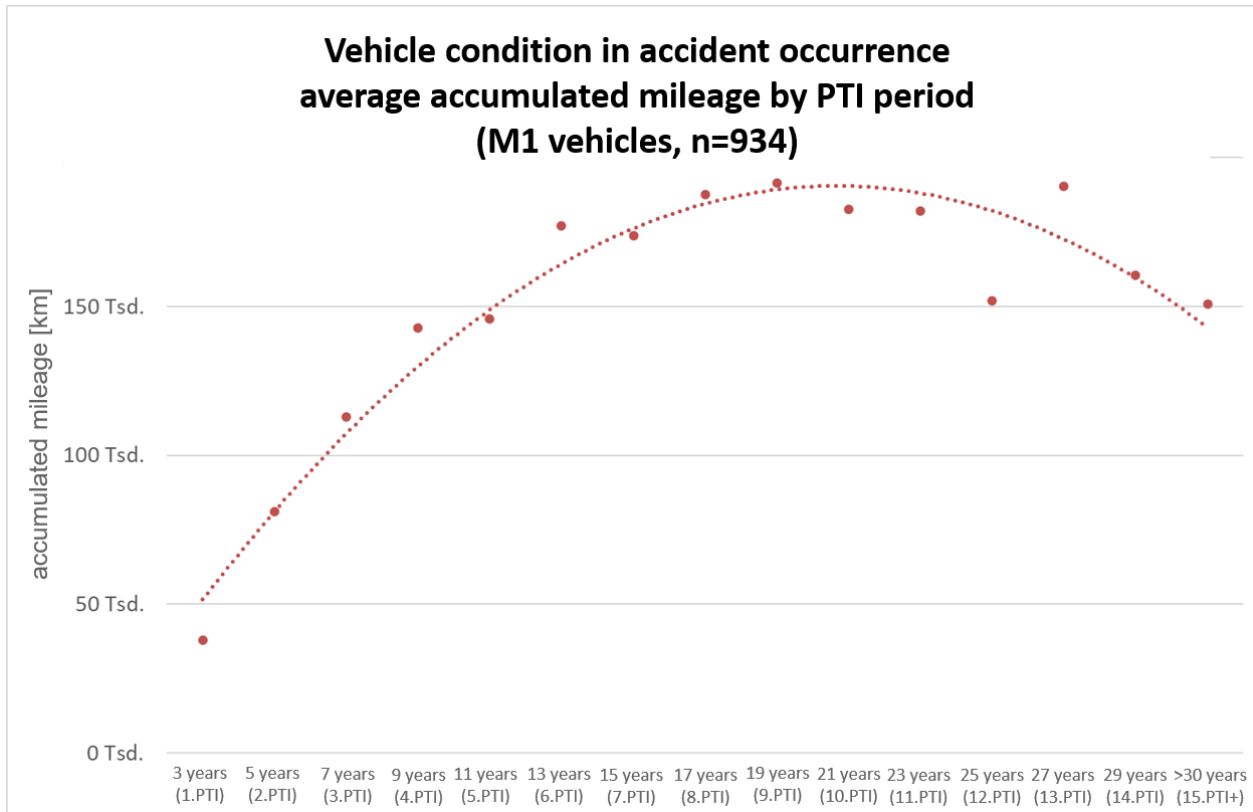


For all evaluations in this study, grouping by PTI period was carried out on the basis of vehicle age and the date of the next PTI.

In Germany, passenger cars can be classified and registered as classic cars from an age of 30 years. These predominantly enthusiast vehicles differ significantly in their care and maintenance condition and in their usage profile compared with vehicles used for everyday transport. For this reason, and because of the limited data basis for vehicles aged 25 to 30 years, the derivations for category M1 vehicles in the further course of this study can in some cases only be carried out up to an age of 24 years.

Figure 57 shows the distribution of the mileage of vehicles that underwent a technical inspection after a road accident.

Figure 57: Vehicle condition in accident occurrence - mileage distribution by PTI period



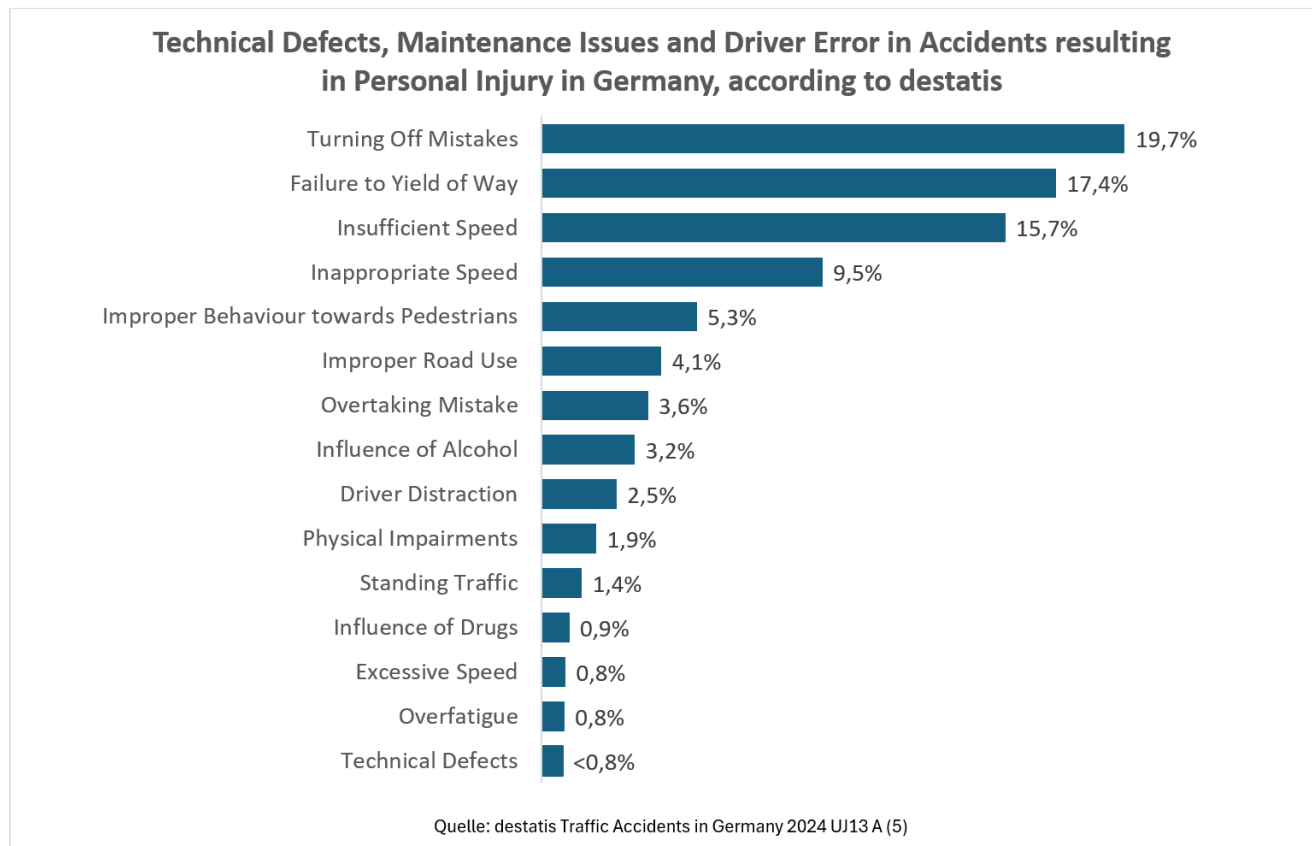
The distribution of the mileage of passenger cars in accident occurrence by vehicle age is comparable with the mileage distribution of passenger cars in traffic shown in Figure 35. The declining mileage from the 25th year onward is presumably explained by the increasing share of enthusiast vehicles (youngtimers) from a vehicle age of 25 years and classic cars from the 30th year onward.

5.5 Accident-relevant technical defects and official road-accident statistics

In the targeted survey of data obtained by DEKRA experts in accident analyses, 6.4% of the category M1 passenger cars involved in the accidents under consideration had accident-relevant technical defects.

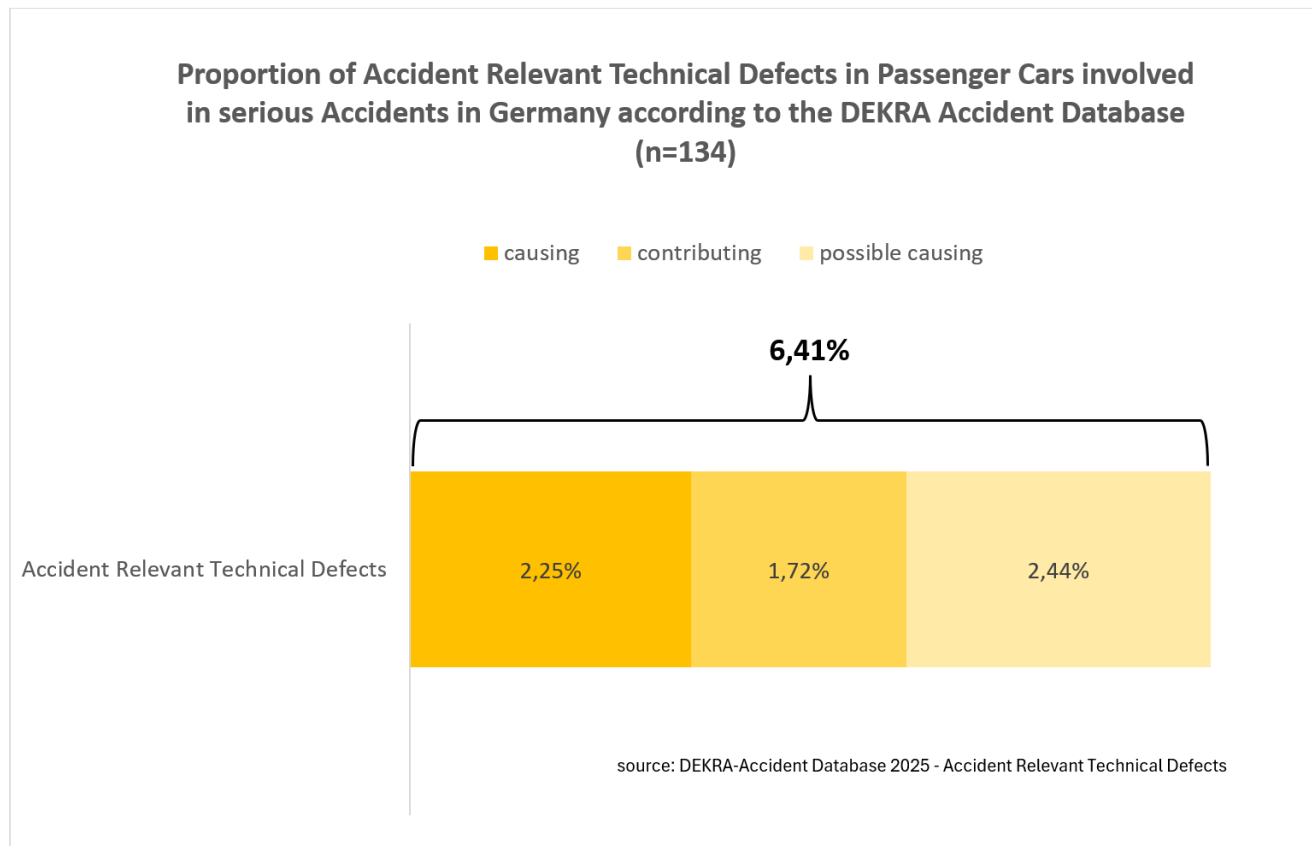
Even though this figure is comparable only to a limited extent with the most frequent causes recorded by police officers for passenger-car drivers in accidents involving personal injury, it is compared with the official road-accident statistics in Figure 58.

Figure 58: Vehicle condition in accident occurrence - technical defects, maintenance defects and driver misconduct among passenger-car drivers in injury accidents in Germany in 2024



The technical and maintenance defects, or driving with accident-relevant technical defects, among passenger-car drivers involved in accidents in Germany according to the DEKRA accident database are shown in Figure 59.

Figure 59: Vehicle condition in accident occurrence - share of accident-relevant technical defects and maintenance defects among passenger cars involved in serious accidents in Germany according to the DEKRA accident database



At 6.4% in total, accident-relevant technical defects rank ahead of driving under the influence of alcohol and drugs, distraction while driving, driving while overtired and driving at excessive speed, while the official road-accident statistics report technical defects and maintenance defects at a rate below 0.8%.

These differing rates are explained by the fundamentally different methods of data collection. In police accident recording, which forms the basis of the official accident statistics, the scope for recording accident causes is limited to a maximum of three entries per accident participant and is generally based on the characteristics externally visible to police officers during accident recording.

By contrast, the analyses underlying this study are based on technical vehicle inspections by experts. Their scope for recording accident causes relating to the accident participants is not limited and is supplemented by the findings of an accident-analysis assessment. Thus, the accident causes in expert accident analyses are broader and are not disjoint from other accident causes.

For example, in an expert accident analysis, reduced braking performance identified by the expert due to worn wheel brakes may be a contributory cause of the accident, the accident consequences and the accident severity, alongside other misconduct such as driving with insufficient safety distance and at an inappropriate speed.

The evaluation of the technical inspections performed on the passenger cars involved in the accidents as part of the accident analyses results in the following summary of defect assessment:

Table 10: Vehicle condition in accident occurrence - distribution of categories for accident-relevant technical defects in the dataset

Categories (n = 2,093)	Causal	Contributory	Possibly causal	Accident- relevant (total)
Number	47	36	51	134
Percent	2.25%	1.72%	2.44%	6.41%
95% confidence interval	[1.67; 3.00]	[1.24; 2.37]	[1.86; 3.19]	[5.43; 7.53]

In addition, the expert accident analyses show a pronounced dependence of the share of accident-relevant technical defects on vehicle age. As vehicle age increases, the corresponding share rises substantially. Against this background, the further procedure does not calculate with the aggregate value of 6.4% across the board. Instead, the age-dependent distribution of accident-relevant technical defects is taken into account and applied in differentiated form for the further estimates.

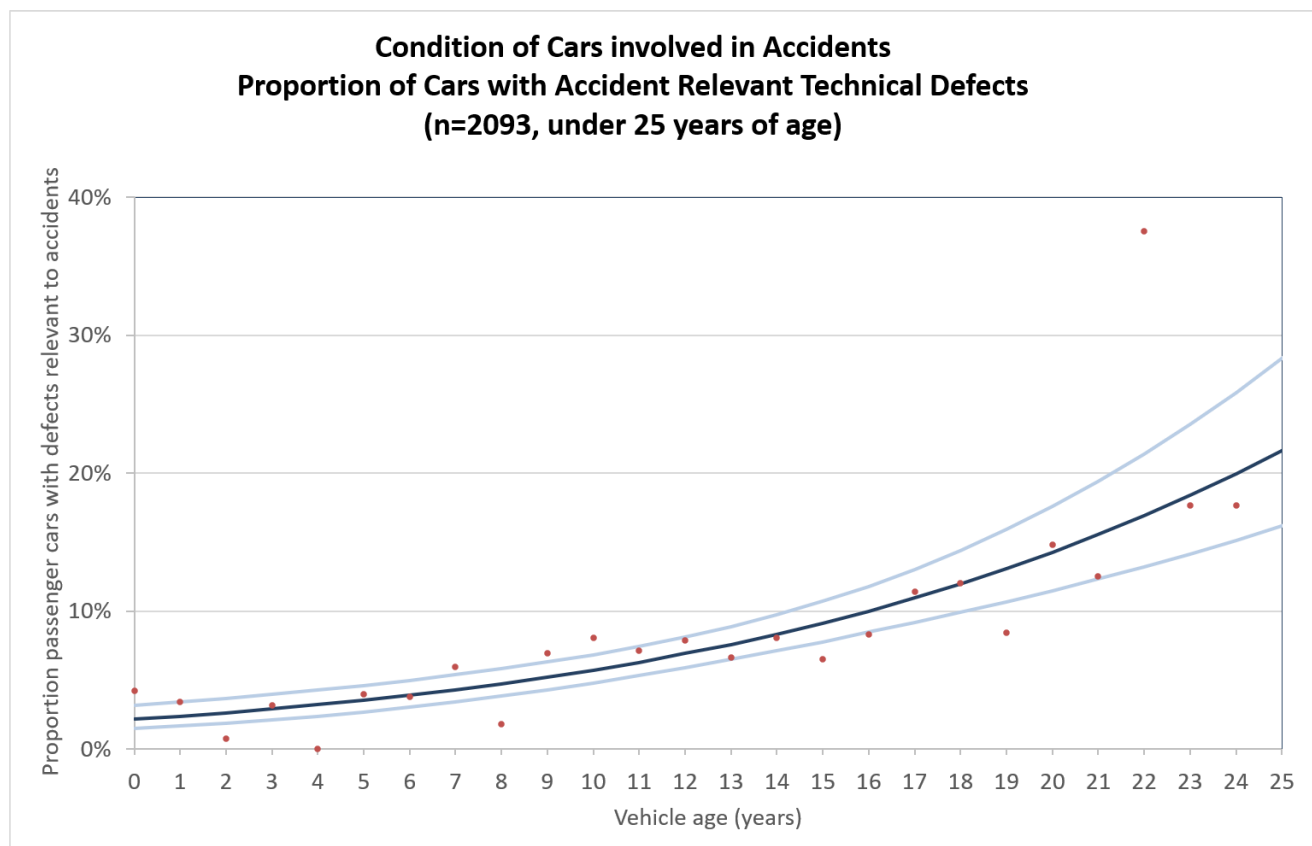
5.6 Accident-relevant technical defects and vehicle age

To classify the transferability of the results of the technical inspections within the accident analyses, the dependence of accident-relevant technical defects on vehicle age for category M1 vehicles was compared with the official KBA statistics on PTI results and with the results of the field sample on the condition of vehicles in traffic. The comparison shows that the survey carried out by accident analysts according to the specifications of the study leaders exhibits, in the essential characteristics of the identified defects, a comparable increase depending on vehicle age to that found in the official KBA data on PTI results and in the field-sample results.

To quantify the relationship between vehicle age and the occurrence of accident-relevant technical defects, logistic regression was used. This method is particularly suitable because the dependent variable is dichotomous, i.e. it distinguishes between vehicles with and without accident-relevant technical defects. Vehicle age was included as the explanatory variable in order to model how the probability of an accident-relevant defect changes as the vehicle becomes older.

The regression results show a clear positive relationship between vehicle age and defect probability. For very young vehicles, the estimated share of accident-relevant technical defects is initially at a low level of around 2%. As vehicle age increases, however, this share rises continuously. This indicates that technical ageing, wear and maintenance effects may become increasingly accident-relevant with growing duration of use. For vehicles aged around 24 years, the estimated probability of accident-relevant defects reaches values of approximately 20%. This shows that older vehicles in the sample considered have a significantly increased risk of exhibiting technical defects relevant in the accident context.

Figure 60: Vehicle condition in accident occurrence - share of passenger cars with accident-relevant defects in technical inspections after road accidents



For vehicles aged 25 years and older, however, the meaningfulness of the estimate is limited. In this age range, case numbers are comparatively low, which significantly increases the uncertainty of the modelled values. The corresponding estimates are therefore no longer statistically robust to the same extent and are not interpreted as a robust continuation of the previously observed trend. For the further calculation, the age-dependent relationship is therefore considered primarily in the range for which a sufficiently strong empirical data basis exists.

5.7 Conclusion on vehicle condition in accident occurrence

The analysis of technical defects in accident occurrence shows that the official road-accident statistics can reflect the influence of technical defects only to a limited extent. Since technical defects are recorded there essentially on the basis of externally visible characteristics during police accident recording, systematic under-recording must be assumed. The share of technical defects as an accident cause reported in the official statistics, at around 0.8%, should therefore not be understood as a complete representation of the actual significance of technical defects in accident occurrence.

By contrast, the DEKRA accident database offers a more differentiated data basis because it is based on technical assessments by experts in the context of specific accident analyses. For the present investigation, datasets of accident-involved passenger cars in vehicle category M1 were evaluated. The dataset predominantly comprises serious accidents involving personal injury from the last ten years and thus enables a current analysis of accident-relevant technical defects in this accident segment.

At the same time, the meaningfulness of the data is limited by the specific way in which the dataset was created. The examined cases are not a random sample of overall accident occurrence; rather, they are based predominantly on accident-analysis expert reports concerning more serious or more deeply investigated accident events. Minor accidents involving property damage only are included only rarely. In addition, the technical inspections within the accident analyses generally focus on components and systems that appear relevant to the respective accident sequence. A complete technical inspection of all components and systems, such as in the context of a PTI, is not carried out.

The comparison with the official accident statistics shows that the DEKRA accident data do not exhibit any fundamental structural deviations in terms of vehicle age, driver age and driver sex. However, comparability was checked only on the basis of selected structural characteristics. Secure representativeness for the entire official accident occurrence cannot be inferred from this. Rather, it remains necessary to take into account that the special selection of examined cases may lead to systematic deviations that cannot be conclusively determined with the available data.

For the further analysis, this means that the DEKRA data should not be understood as a fully representative depiction of overall accident occurrence. They do, however, constitute a meaningful, professionally plausible and, compared with the official accident statistics, much deeper basis for estimating the share of accident-relevant technical defects in the serious accidents involving personal injury considered here. Of particular relevance is the demonstrated age-dependent relationship: as vehicle age increases, the probability of accident-relevant technical defects rises markedly. Therefore, the further calculations do not

use a flat aggregate share of technical defects, but take account of age-dependent defect probability.

In summary, technical defects play a larger role in accident occurrence than is visible from the official accident statistics. Taking into account the limitations mentioned, the accident-analysis data from DEKRA experts permit a robust approximation of the potential of accident-relevant technical defects in serious passenger-car accidents involving personal injury. At the same time, they demonstrate the need for further investigations that record technical inspections for accident-relevant defects after accidents more systematically and broadly as a basis for further road-safety research, in order to quantify the role of technical defects in accident occurrence even more reliably.

6 Analysis and modelling of defect rates on the basis of the field investigation

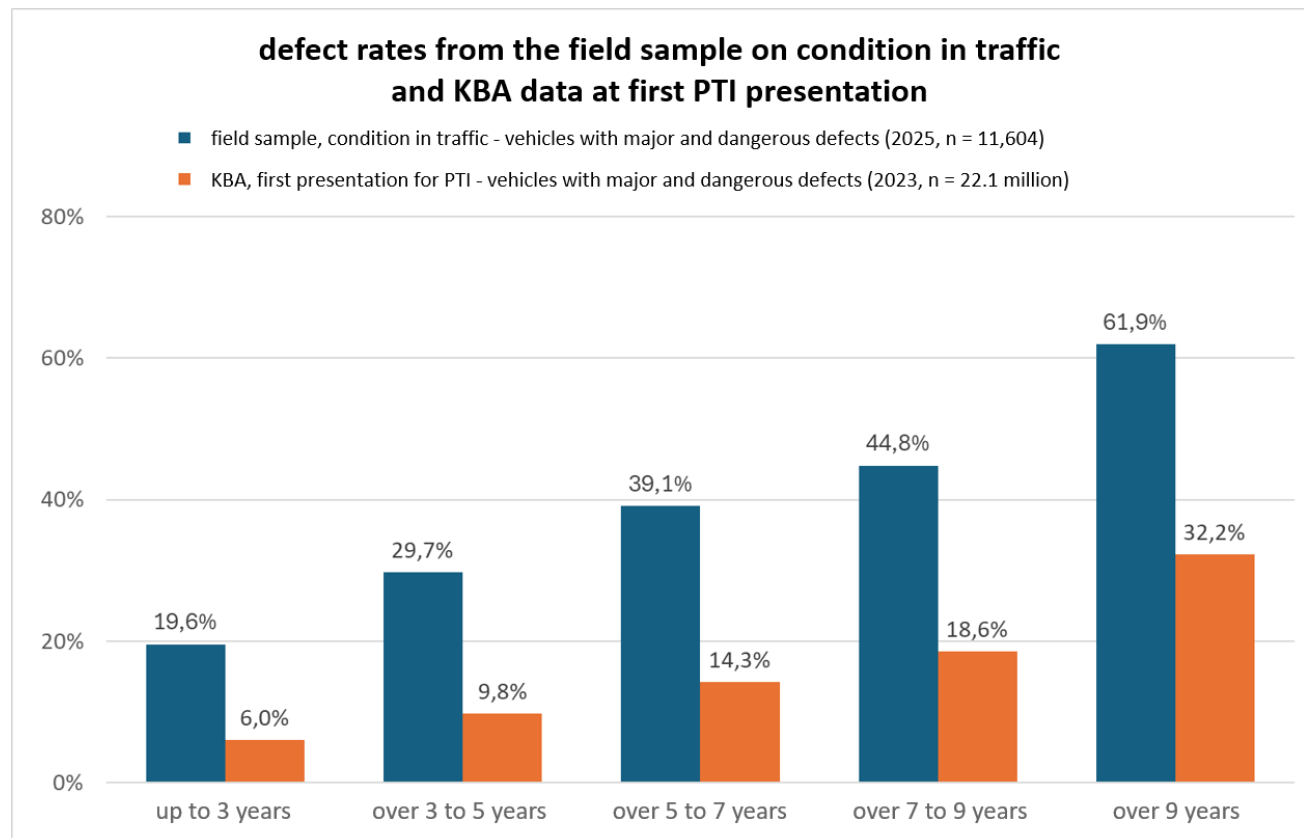
In this chapter, the results of the field sample on the condition of vehicles in traffic are evaluated in order to provide various measures and correlations for the subsequent potential estimate as a function of different PTI inspection intervals and forecast scenarios. The basis for the potential estimate is the periodic reset model of defect probabilities developed within the framework of the study in Chapter 6.2.

The statistical evaluation and modelling of the various measures and correlations were carried out using the statistical software R and subsequently processed in Microsoft Excel.

6.1 Defect rates as a function of vehicle age

In the following chart (Figure 61), the defect rates from the field sample on the condition of vehicles in traffic were compared with the defect rates recorded by the Federal Motor Transport Authority (Kraftfahrt-Bundesamt, KBA) at the first presentation for periodic technical inspection. The defect rate at the first presentation for PTI represents the share of vehicles that were not granted an inspection sticker at their first presentation for PTI.

Figure 61: Statistical analysis - comparison of defect rates: vehicle condition in accident occurrence and KBA first presentation for PTI

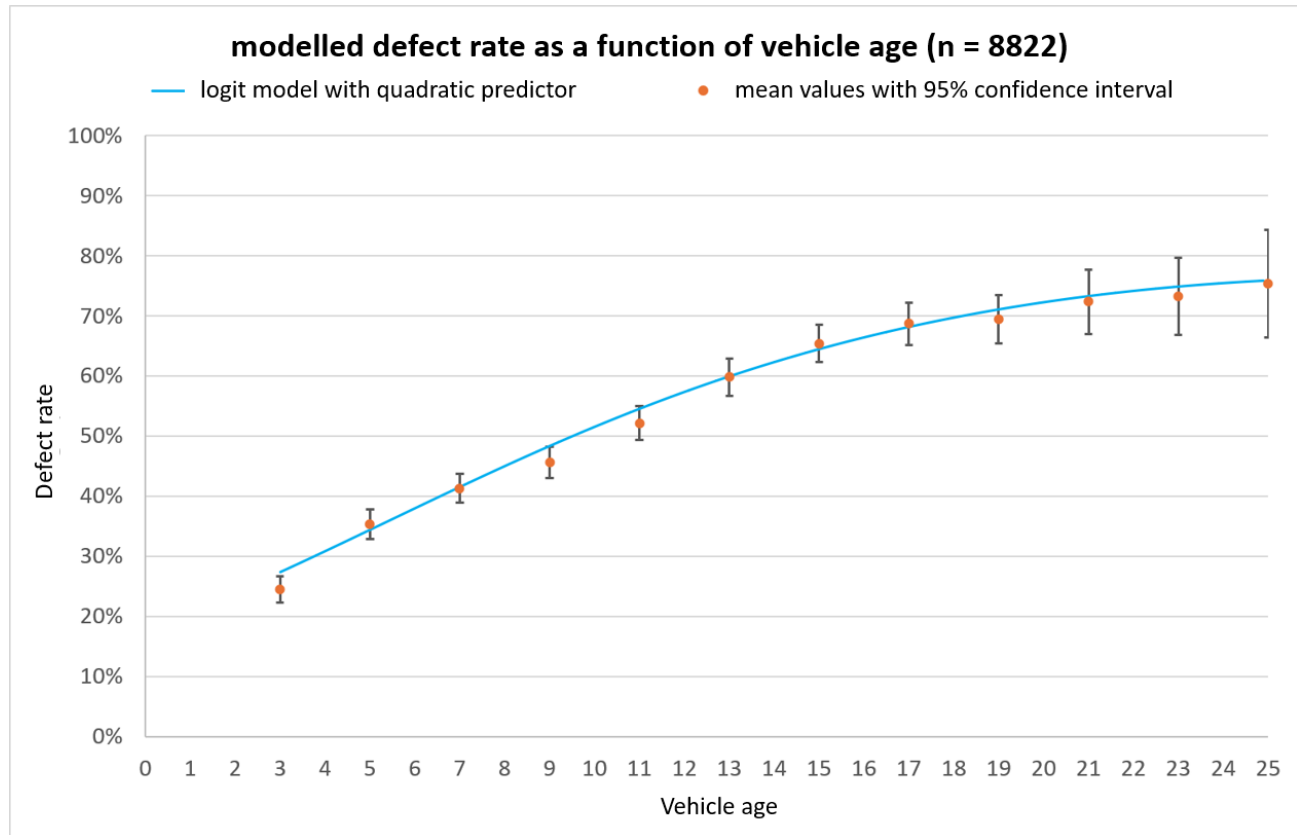


The comparison shows a substantially higher defect rate among vehicles in traffic that were examined before repair and maintenance in connection with an upcoming periodic technical inspection.

Accordingly, before repair and maintenance in connection with the PTI, defect rates for passenger cars in traffic are two to three times higher than at the first presentation for PTI, because vehicles are deliberately prepared for the upcoming inspection. For vehicles more than nine years old, the defect rate in traffic is just under 62%, whereas at first presentation for PTI, on average only around 32% of vehicles fail to receive a sticker.

Since the age grouping used in the KBA data provides only a rough age classification, a defect rate as a function of vehicle age in one-year age classes was modelled on the basis of the field-sample data. The following figure (Figure 62) shows this modelled defect rate as a function of vehicle age together with the 95% confidence interval.

Figure 62: Statistical analysis - modelled defect rate by vehicle age



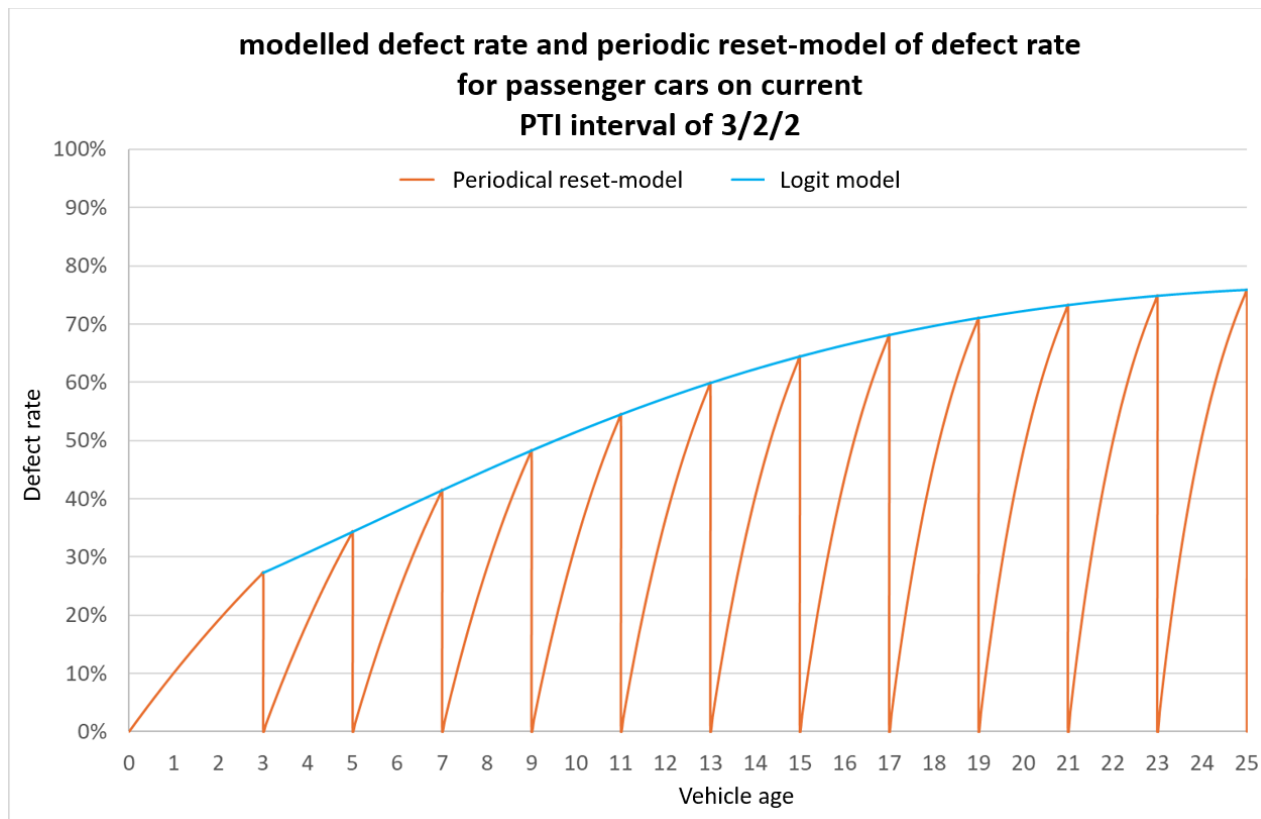
A baseline curve was modelled using the field-sample data. The blue curve assigns to each vehicle age the modelled probability that a vehicle has at least one major or dangerous defect before repair or maintenance in connection with the upcoming PTI. It was generated using a logistic regression model with a quadratic predictor. The orange dots show the observed shares in the respective age classes from the dataset. The error bars are 95% confidence intervals for these shares and were calculated from all vehicles in the relevant age class. The figure shows that the displayed defect rate rises quite sharply in the first years and is around 75% for vehicles aged 25 years.

6.2 The periodic reset model of defect probability

The periodic reset model of defect probability is introduced below. It serves to describe the defect rate as a function of vehicle age.

Figure 63 below shows the transfer of the defect rate modelled in Figure 62 into the periodic reset model of defect probability. This reset model is based on the fact that, at the time when a PTI sticker is issued, vehicles must not have any major or dangerous defects, regardless of how many presentations for PTI were required in order to receive the sticker.

Figure 63: Statistical analysis - modelling the defect rate with PTI influence



The blue curve shown again represents the modelled defect rates by vehicle age (see Figure 62). It shows the defect probability at the points in time before vehicles underwent repair and maintenance in connection with the PTI. Since vehicles must no longer have any major or dangerous defects immediately after a passed PTI, the corresponding defect probability is reset in the model to the initial value at the PTI point in time. Starting from this initial value, the probability then rises again up to the level specified by the blue curve before the next upcoming PTI.

It is assumed that the defect probability (orange curve) within each PTI period approaches a trajectory that can be described by the exponential distribution. Exponential-distribution trajectories are often used to model “waiting times”; in this case, the “waiting time” until the first major or dangerous defect. The target level is the defect probability specified by the logistic regression for the respective next PTI point in time. In order to reach precisely this target level, the parameter of the exponential distribution is chosen appropriately in each interval.

The trajectory of the periodic reset model of defect probability (orange curve) can be read in two ways. First, for an individual vehicle, it describes the sequence of defect probabilities over vehicle age if the prescribed PTI inspection intervals are followed exactly. Second, it can be read as an idealised fleet interpretation. Among all vehicles of age x , the curve value

corresponds to the share of vehicles with at least one major or dangerous defect, assuming that the vehicles comply with the specified PTI inspection intervals. Since vehicles are presented for PTI both before the due date and after the due date, this reset model can be applied to the entire passenger-car fleet by interpreting it as an averaged trajectory across the overall fleet.

The curves are chosen so that, in the absence of further PTI inspections, the probability of a defect approaches a level of one exponentially. This modelling is appropriate for several reasons. First, the exponential distribution is an established approach for describing waiting times until the occurrence of an event, here until the first occurrence of at least one major or dangerous defect. Second, it ensures a plausible value range for the modelled defect probability between 0 and 1 and describes a monotonically increasing trajectory within the respective PTI period. Third, it also allows meaningful behaviour beyond the currently applicable inspection interval. This is particularly relevant for the present study because different PTI inspection intervals and forecast scenarios are considered later on. The model must therefore not only reflect the defect probability at the end of the existing inspection period, but must also allow a professionally defensible projection for longer or shorter inspection intervals.

Nevertheless, the specific trajectory within a PTI period should be understood as a modelling assumption. The field sample primarily provides information on the condition of vehicles before repair and maintenance in connection with an upcoming periodic technical inspection. It therefore allows a robust estimate of the target level at the end of a PTI period, but not an equally direct empirical observation of the entire temporal trajectory between two periodic technical inspections.

Whether the defect probability within an inspection period actually increases exponentially, approximately linearly or according to another trajectory cannot therefore be conclusively clarified using the available data. Empirical validation would require, in particular, event-independent technical inspections of vehicles at different points in time within an ongoing PTI period, rather than only immediately before an upcoming periodic technical inspection.

This limitation must be taken into account for the present potential estimate. The exponential distribution is therefore not understood as a proven real mechanism for the emergence of technical defects, but rather as a plausible and mathematically consistent model of defect build-up between two PTI points in time. Sensitivity analyses also show that alternative curve trajectories often lead to similar orders of magnitude in the potential estimate. This was examined in particular for linear interpolation between the reset point and the modelled defect rate at the end of the PTI period. Although the results of the subsequent calculations are thus based on a modelling assumption, the sensitivity check

indicates that the order of magnitude of the potential estimate remains largely stable relative to alternative plausible curve trajectories.

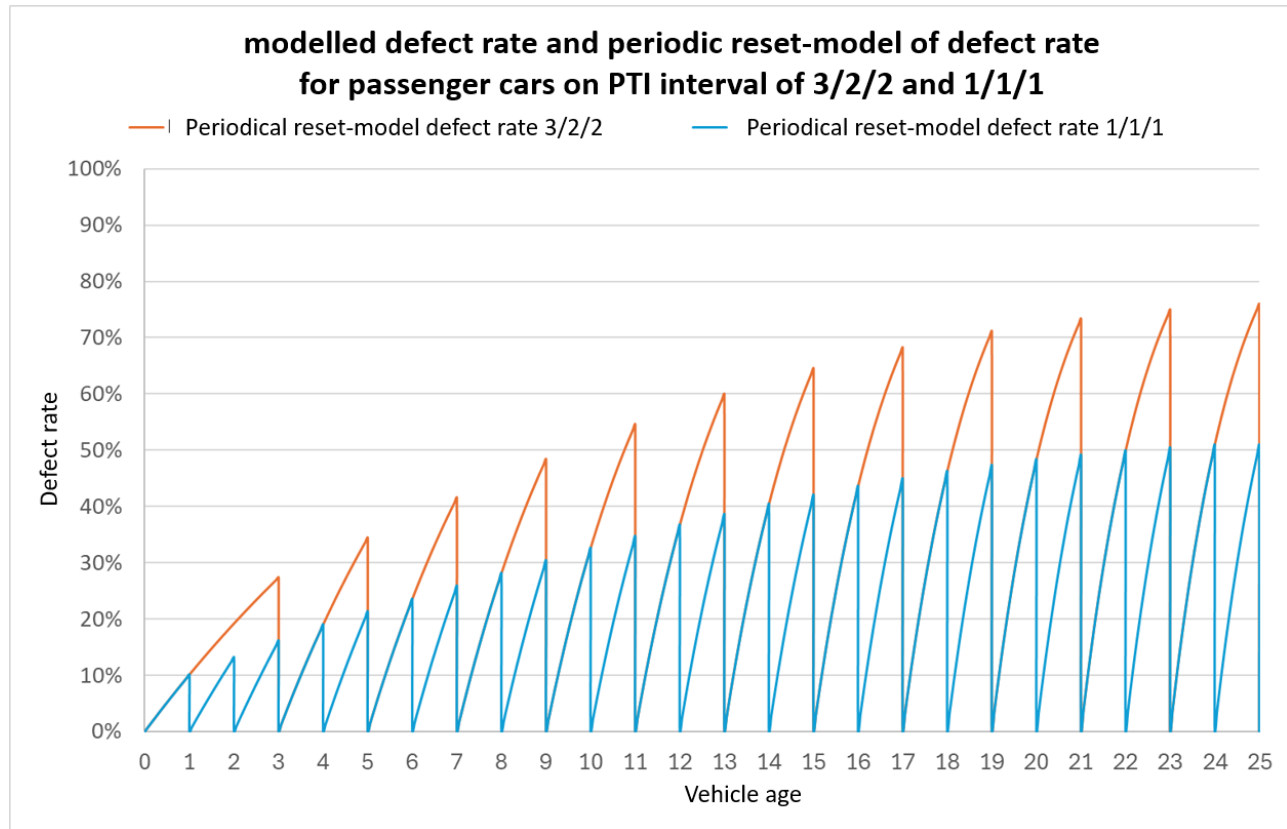
On this basis, the reset model can be used not only to describe the current 3/2/2 PTI interval, but also for comparative assessment of alternative inspection intervals. In what follows, the purpose is expressly not to propose a specific new inspection procedure. In particular, annual inspection from first registration is not to be understood as a recommended rule. Rather, it serves as a methodological comparison scenario that can be used to show how the model can be applied to different PTI inspection intervals.

6.3 Comparison of different inspection intervals

The central advantage of the model is that it makes it possible to represent a change from the current 3/2/2 inspection interval to shorter inspection intervals at any vehicle age. This makes it possible, for example, to examine what calculated reduction potential would arise if vehicles were not inspected annually over their entire service life, but only from a certain age onward, or what negative effect an extension of inspection intervals would have on the total number of defective vehicles in traffic. The model is therefore flexible enough to compare different transition points and interval schemes and to quantify their respective potential.

In order to illustrate how the reset model can represent a transition from the current 3/2/2 PTI inspection interval to annual inspections, Figure 64 compares two reference trajectories of defect probability. It shows the trajectory under the current 3/2/2 interval and the hypothetical trajectory under an annual 1/1/1 PTI inspection interval. The latter does not serve as a regulatory proposal, but as a comparison curve on the basis of which transitions to annual inspections from different vehicle ages can be modelled.

Figure 64: Statistical analysis - modelling defect rates for different PTI inspection intervals

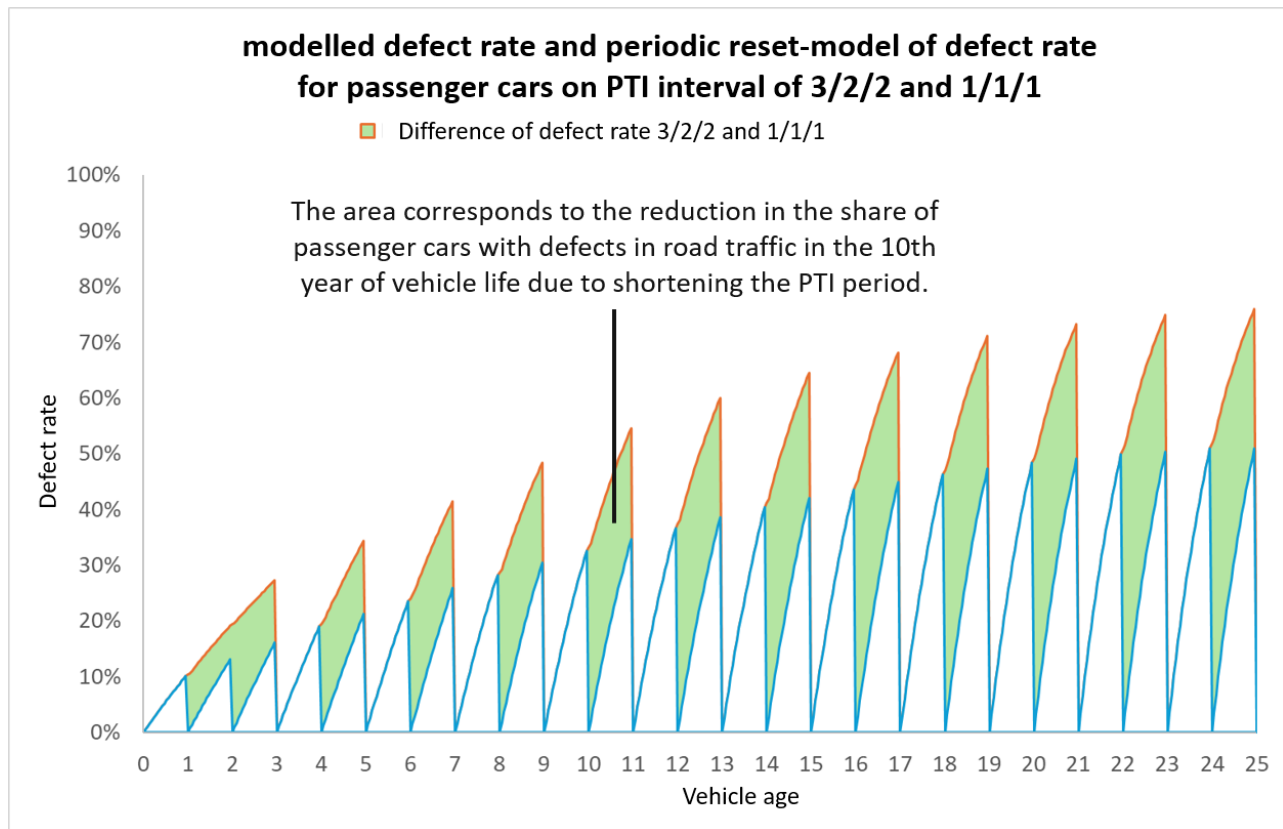


In the case of an annual PTI inspection interval, the defect probability would be reset to zero once a year and would then rise again within the respective year according to the modelled trajectory.

The two curves can be interpreted such that, depending on the rule considered, the system switches from the current 3/2/2 interval to annual inspections over the course of vehicle age. A 3/2/2/1/1 scheme, for example, would mean that vehicles are inspected in accordance with the current PTI interval up to an age of ten years and then enter an annual inspection cycle. Up to the transition point, the defect probability therefore follows the trajectory of the 3/2/2 curve; from the transition point onward it follows the trajectory of an annual inspection.

The area under the respective curve within an age year corresponds to the average share of vehicles of that vehicle age with at least one major or dangerous defect. The difference between the areas of two inspection intervals can therefore be interpreted as a calculated reduction potential. In Figure 65, this principle is illustrated using the difference between the current 3/2/2 PTI inspection interval and an annual inspection.

Figure 65: Statistical analysis - determining the differences between different PTI inspection intervals



A switch from the 3/2/2 PTI inspection interval to annual inspections generates a calculated reduction potential wherever the additional periodic technical inspection causes the defect probability to be reset again. If the inspection dates coincide in both interval schemes, for example after three years, the defect probability in both models starts again at zero and initially rises identically. Differences arise only in those age intervals in which an annual interval scheme would involve an additional PTI, while no renewed inspection is yet provided for in the current 3/2/2 system.

The green difference areas between the curves show this calculated reduction potential in the affected age years. For each age interval $[x, x+1]$, they correspond to the difference between the annual areas under the two curves. They therefore indicate the difference in the average share of vehicles with at least one major or dangerous defect between the inspection intervals considered. In this way, the model can not only represent the extreme comparison between 3/2/2 and 1/1/1, but can also assess any transition scenarios in which a switch is made from the previous PTI interval to annual inspections from a specific vehicle age onward.

For the extrapolation of these reduction potentials, for example to a passenger-car fleet by vehicle age in one-year age classes, it is necessary to convert the curve of defect probabilities into annual mean values. This conversion is shown in the following charts

(Figures 66 and 67). The annual areas of the defect probabilities in the periodic reset model were replaced by a piecewise constant curve trajectory. The function value in a given year corresponds to the respective annual area under the curve from the periodic reset model of defect probability, i.e. exactly to the annual mean value of the defect probability at the relevant vehicle age. The areas under the two curves are therefore identical.

Figure 66: Statistical analysis - formation of annual mean values of defect probability for 3/2/2

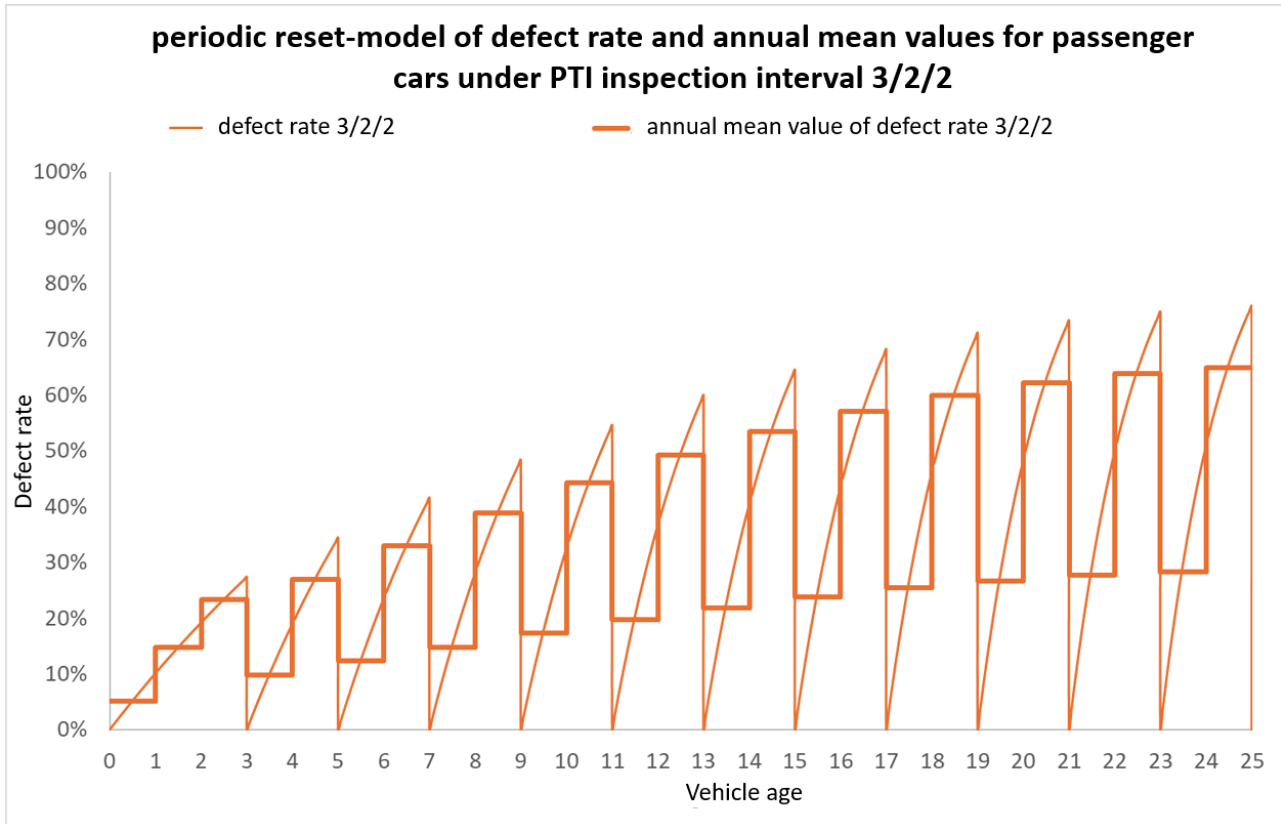


Figure 67: Statistical analysis - formation of annual mean values of defect probability for 1/1/1

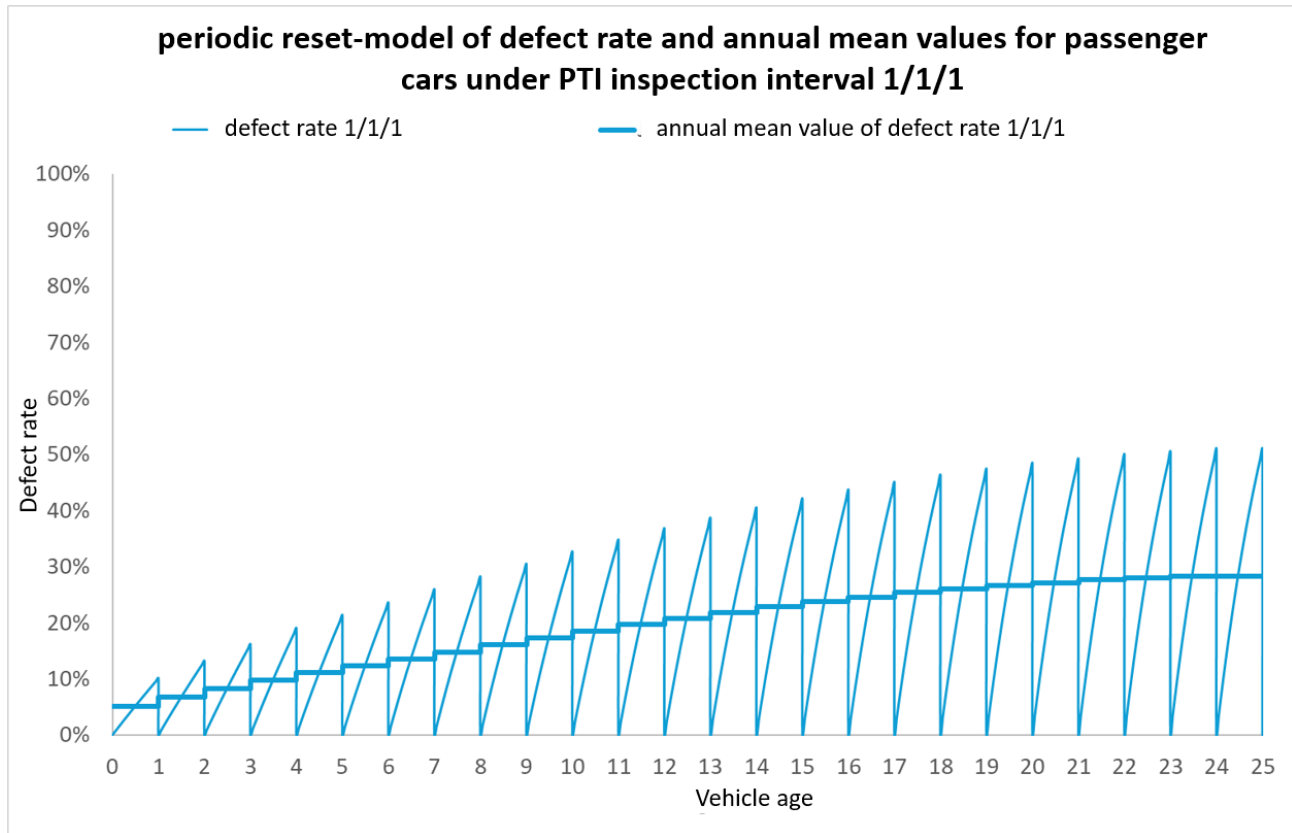
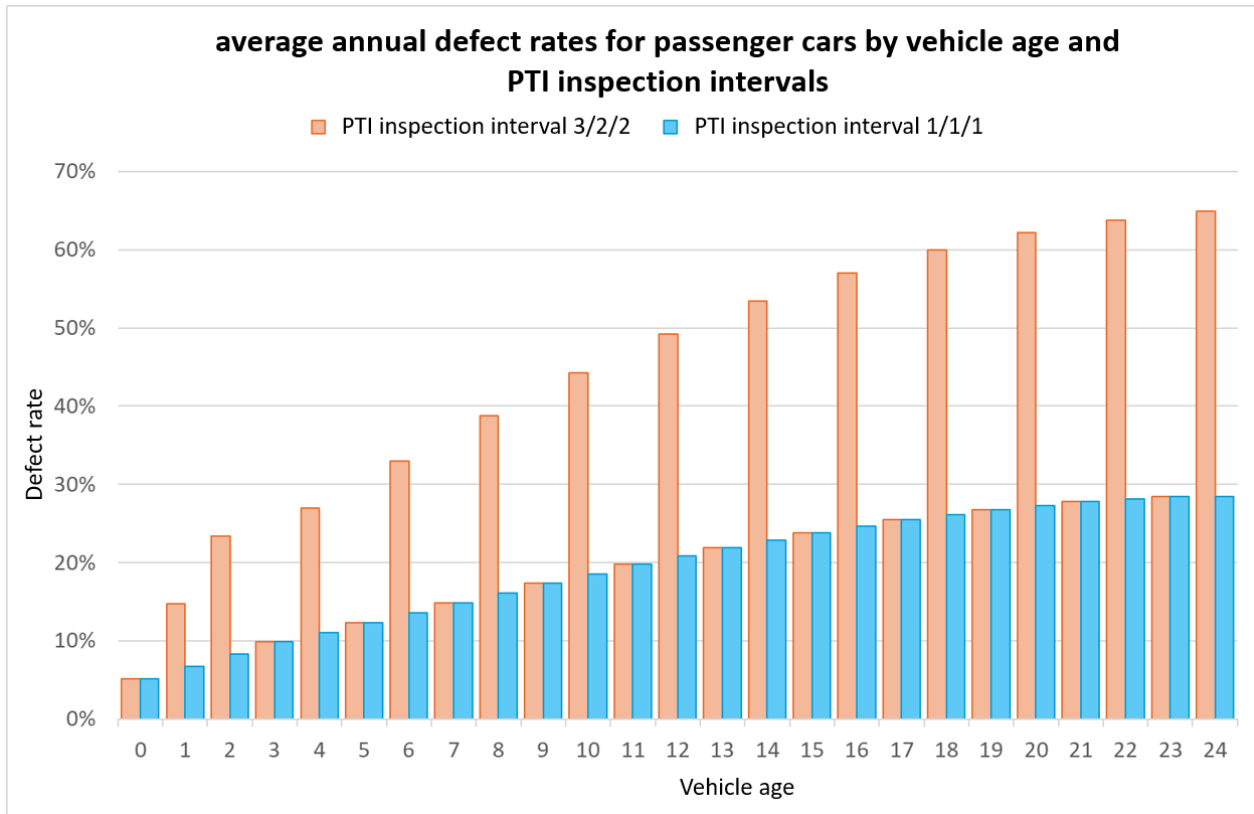


Figure 68 plots the annual mean values of defect probability for the 3/2/2 and 1/1/1 PTI inspection intervals in a single chart. It becomes clear that differences in defect probabilities occur only in years in which there is no PTI under the previous 3/2/2 PTI inspection interval. In the years directly after a PTI in the 3/2/2 system, the annual mean values coincide, whereas in the intervening years the annual system has a lower defect probability.

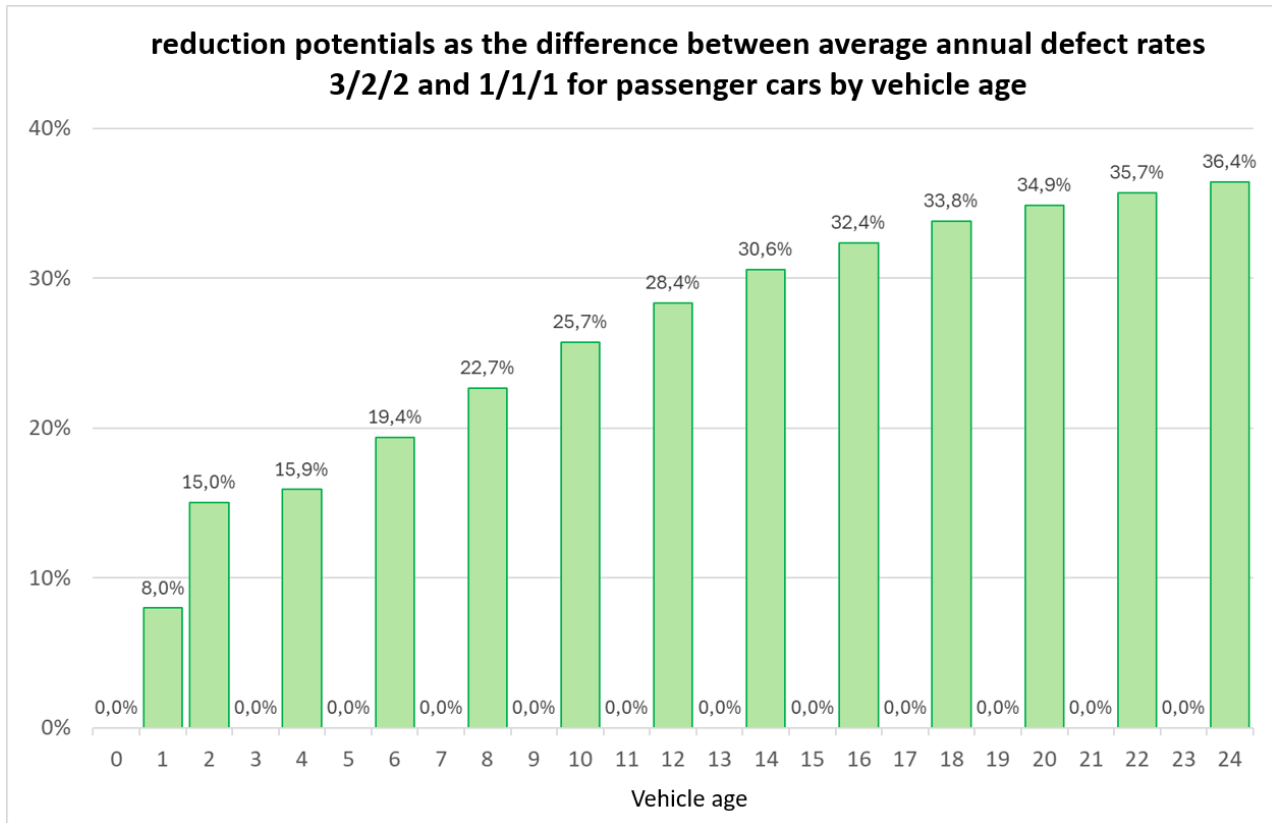
This reduction in defect probability is particularly influential for older vehicles because defect probabilities are generally at a higher level there. For example, for vehicles aged 18 years, the share of vehicles with defects would fall from around 60% to around 26% if a transition to annual PTI were made. According to this model, therefore, among 18-year-old vehicles, it would not be 60% that are on the road with major or dangerous defects, but only 26%.

Figure 68: Statistical analysis - average annual defect rates for different PTI inspection intervals



The following chart shows the absolute reduction potentials of the average annual defect rates. These are between 8.0 and 36.4 percentage points (see Figure 69). The percentage share shown relates to the total number of vehicles at the respective vehicle age. In years in which both interval models provide for a PTI, there is no additional reduction effect compared with the reference scenario.

Figure 69: Statistical analysis - reduction potentials of average annual defect rates

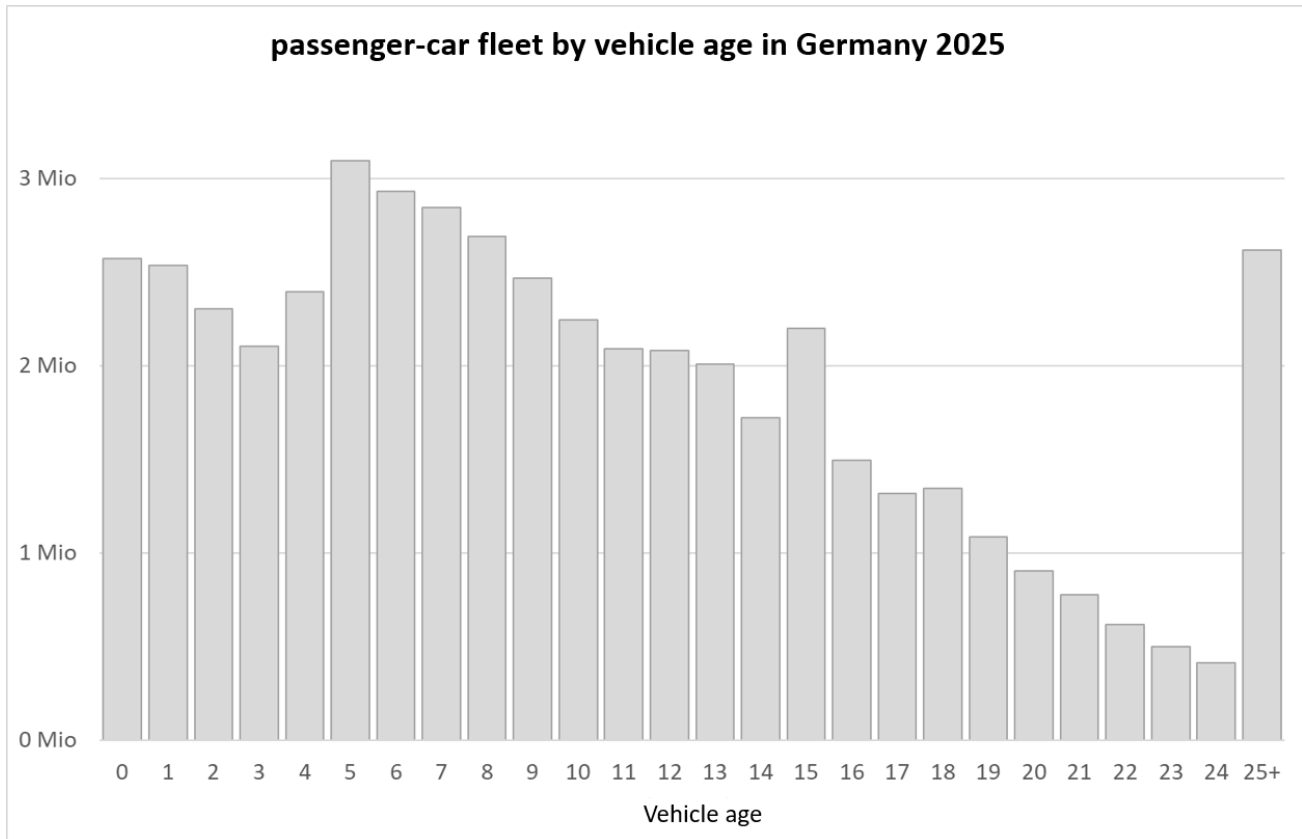


The annual reduction potentials (Figure 69) can now be applied to the total vehicle fleet in Germany.

6.4 Application of the reduction potentials to the passenger-car fleet

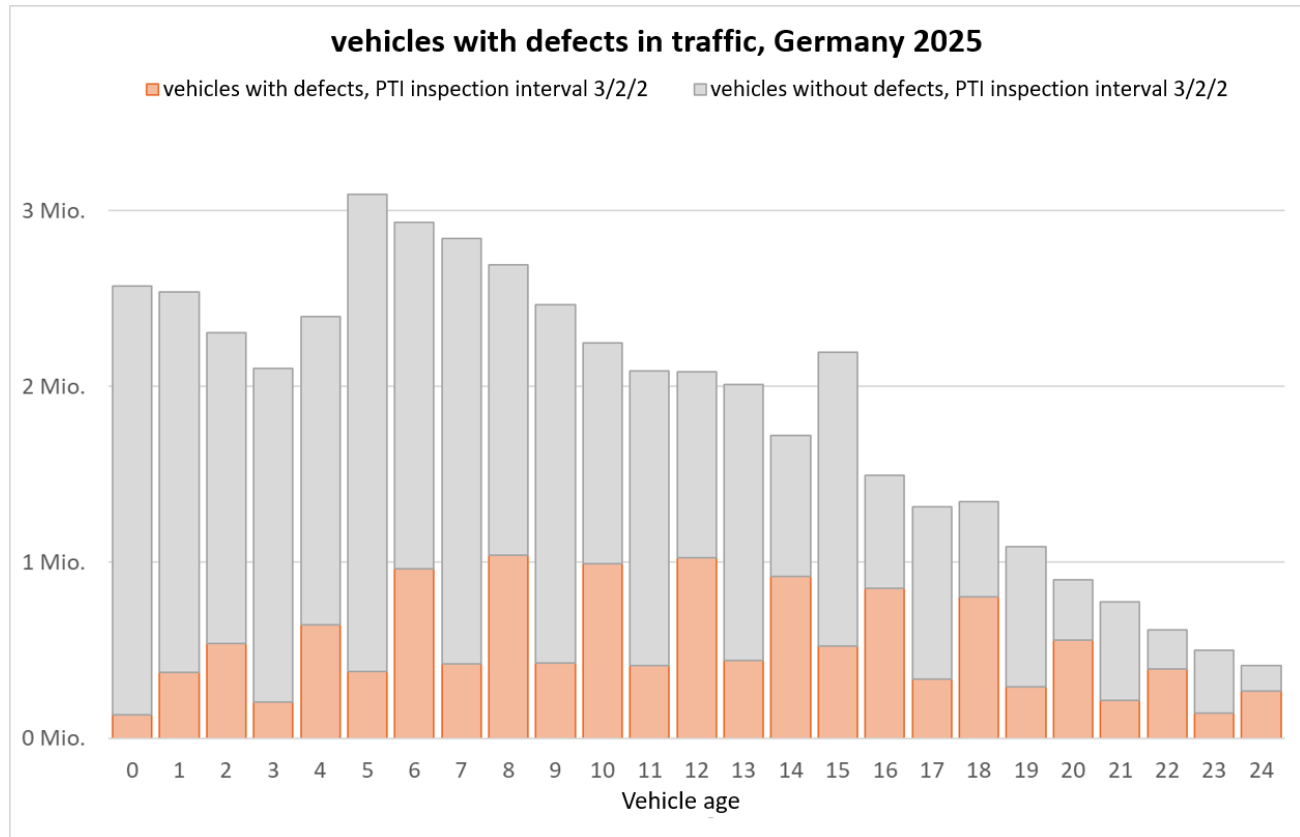
In the study, the passenger-car fleet in Germany (KBA, as at 1 January 2025; see Figure 70) was broken down by vehicle age and used as the basis for extrapolating the defect rates and reduction potentials to overall traffic in Germany.

Figure 70: Statistical analysis - passenger-car fleet in Germany, 01/2025



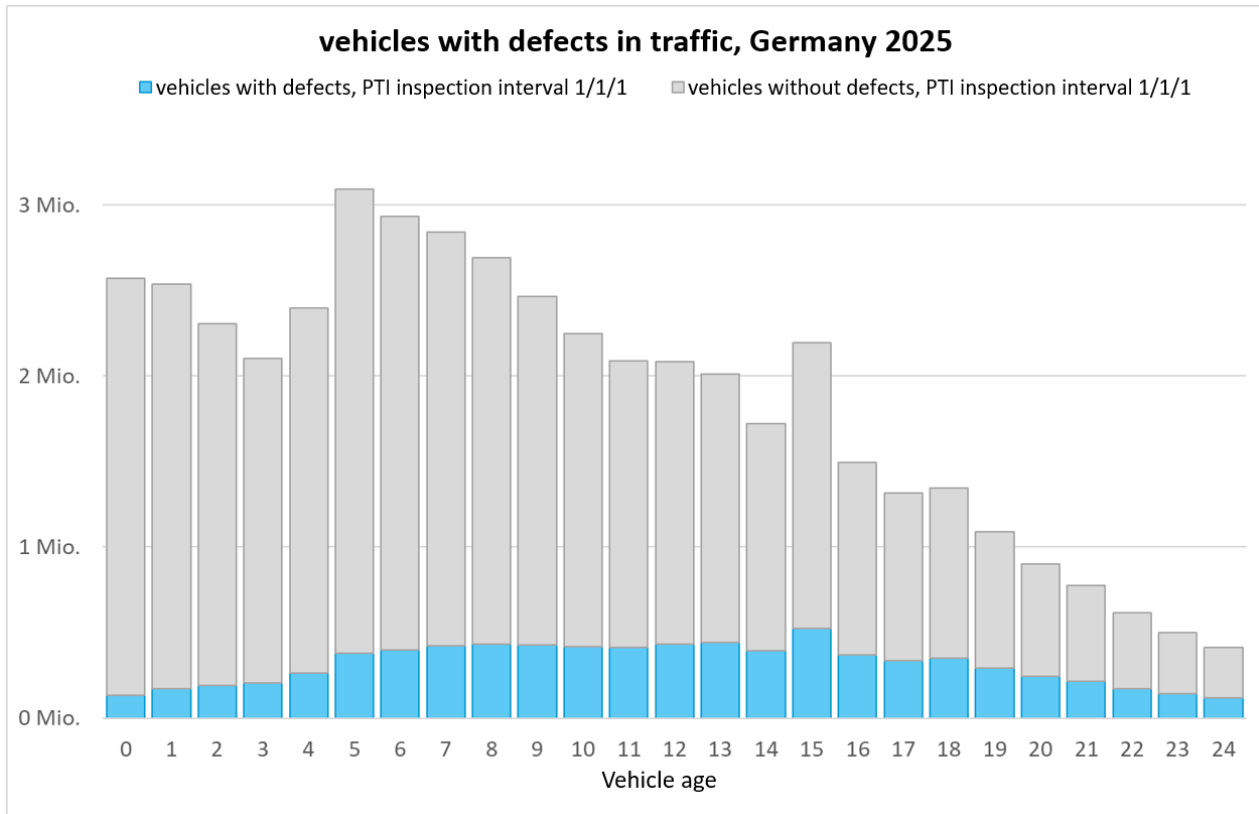
The passenger-car fleet in Germany was combined with the average annual defect rates (3/2/2) shown in Figure 66. This produces the current absolute numbers of passenger cars in Germany, as determined by our model, with at least one major or dangerous defect in traffic by vehicle age. It can be seen that although the number of passenger cars in the fleet decreases with age (grey column), the largest number of vehicles with defects is found at vehicle ages of 8, 10, 12 years and so on. Vehicles in these age classes therefore also offer the highest potential for reducing defect rates in traffic.

Figure 71: Statistical analysis - fleet of passenger cars with defects in traffic in Germany (inspection interval 3/2/2)



The passenger-car fleet in Germany was then combined with the average annual defect rates (1/1/1) shown in Figure 67. This produces the absolute numbers of passenger cars in Germany, as determined by our model, with at least one major or dangerous defect in traffic by vehicle age, assuming an annual PTI inspection interval. Here, too, it can be seen that although the number of passenger cars in the fleet decreases with age (grey column), the largest number of vehicles with defects under this PTI inspection interval is also found in the vehicle-age range of 8 to 18 years.

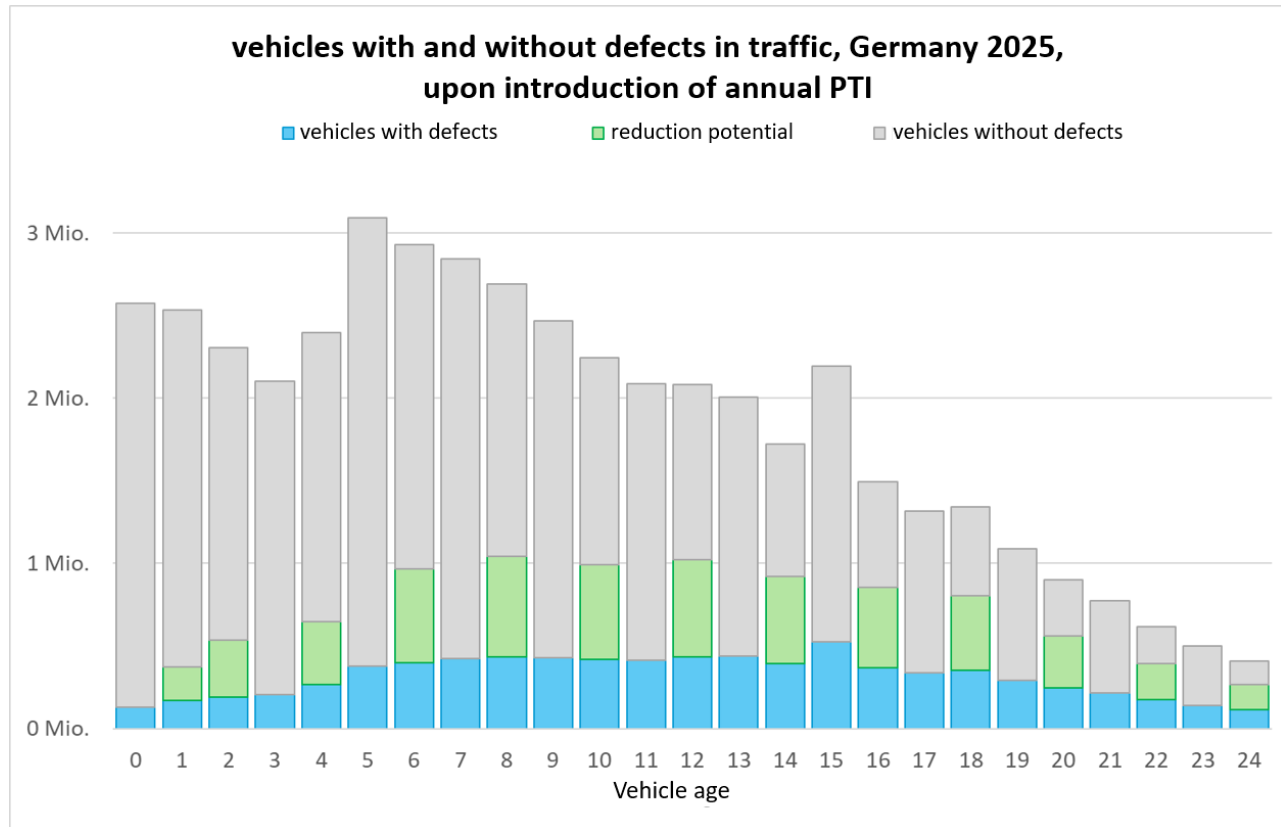
Figure 72: Statistical analysis - fleet of passenger cars with defects in traffic in Germany (inspection interval 1/1/1)



Analogously to the differences between the annual mean values for different PTI inspection intervals (Figure 68), the differences in the passenger-car fleet under different PTI inspection intervals can be determined.

The following Figure 73 shows the passenger-car fleet in Germany divided into vehicles without defects, vehicles with at least one major or dangerous defect under an annual PTI inspection interval, and the potential resulting from the introduction of an annual PTI inspection interval.

Figure 73: Statistical analysis - passenger cars with and without defects in traffic upon introduction of annual PTI



This representation also shows the greatest reduction potential for vehicles with at least one major or dangerous defect in traffic in the age range of 8 to 18 years.

6.5 Conclusion on modelling defect rates

On the basis of the field sample, a periodic reset model of defect probability was developed that can be used to model the relationship between vehicle age, PTI inspection interval and the occurrence of major or dangerous defects. The starting point is the observed defect rate of vehicles in traffic before repair and maintenance in connection with an upcoming periodic technical inspection. This defect rate is significantly higher than the defect rates at first presentation for PTI, which indicates that vehicles are often deliberately repaired in the run-up to the PTI and that PTI statistics reflect the actual defect condition in traffic only to a limited extent.

The model developed transfers the age-dependently modelled defect rate into a periodic trajectory of defect probability. It takes into account that vehicles must not have any identified major or dangerous defects after passing PTI and that the defect probability subsequently rises again until the next PTI. This makes it possible not only to describe the current 3/2/2 PTI inspection interval in model form, but also to examine how alternative inspection intervals would affect the share of defective vehicles in traffic.

One central benefit of the model is that it can flexibly represent different transition scenarios. The annual 1/1/1 PTI inspection interval is not understood here as a specific regulatory proposal, but as a reference scenario. On this basis, it is possible to calculate what reduction potential would arise if, from a certain vehicle age onward, the previous 3/2/2 PTI interval were replaced by annual inspections. The difference between the annual mean values of defect probability describes the estimated reduction in the share of vehicles with at least one major or dangerous defect at the respective vehicle age.

By combining these age-dependent defect probabilities with the passenger-car fleet in Germany, the modelled potential can also be converted into absolute vehicle numbers. This makes visible the age classes in which particularly many vehicles with major or dangerous defects in traffic are to be expected, and the age ranges in which additional inspections would, according to the model, generate the greatest reduction potentials. The modelling shows that these potentials become relevant particularly for older vehicles and, due to the distribution of the fleet, especially in the more heavily represented age classes from around eight years onward.

The results should, however, be interpreted as a model-based potential estimate and are subject to several limitations. The trajectory of defect probability within a PTI period is not directly observed empirically, but is modelled using an exponential function. This assumption is professionally plausible and mathematically consistent, but it does not replace empirical validation of the actual build-up of defects between two periodic technical inspections. More precise verification would require event-independent technical inspections of vehicles at different points in time within ongoing PTI periods. Sensitivity analyses, particularly with linear interpolation, nevertheless indicate that the order of magnitude of the potential estimate remains largely stable relative to alternative plausible curve trajectories.

In addition, the reduction potential determined here initially describes exclusively the modelled decrease in the number or share of passenger cars with at least one major or dangerous defect in traffic. This does not yet provide any direct statement as to how many accidents can be prevented through changed PTI inspection intervals. The transfer of reduced defect probabilities to accident occurrence therefore takes place only in the following chapter. The present chapter provides the methodological and quantitative basis for this by providing age-dependent defect probabilities, annual mean values and reduction potentials for different PTI scenarios.

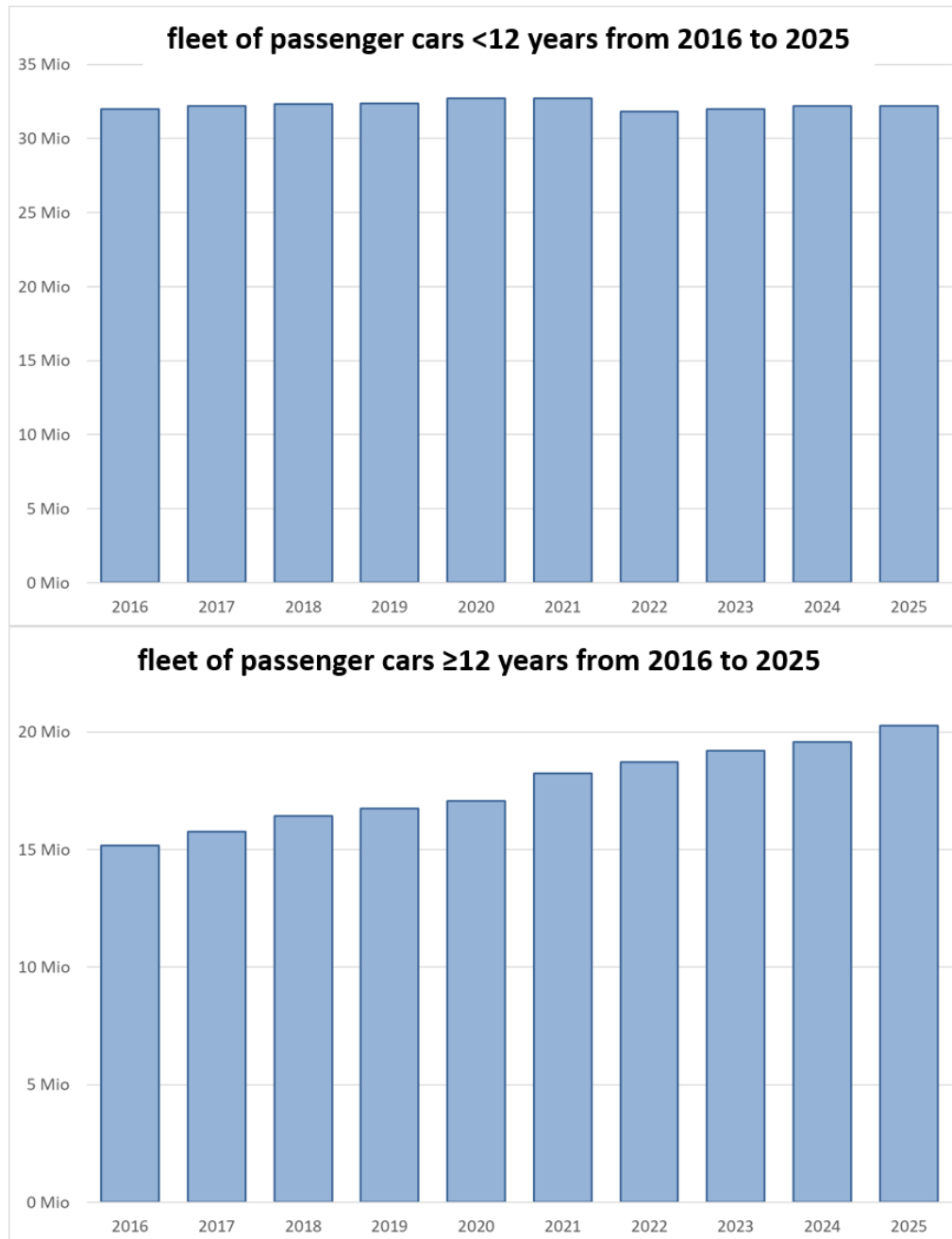
7 Potential estimate for different inspection intervals

The preceding chapters have shown how periodic technical inspections and inspection intervals can influence the share of vehicles with major or dangerous defects in traffic. These effects on the defect rate cannot, however, be transferred directly and proportionally to road safety, because accident occurrence is additionally shaped by mileage, usage patterns, driver characteristics and the actual accident relevance of technical defects.

7.1 Relationship between fleet size, mileage and accident numbers

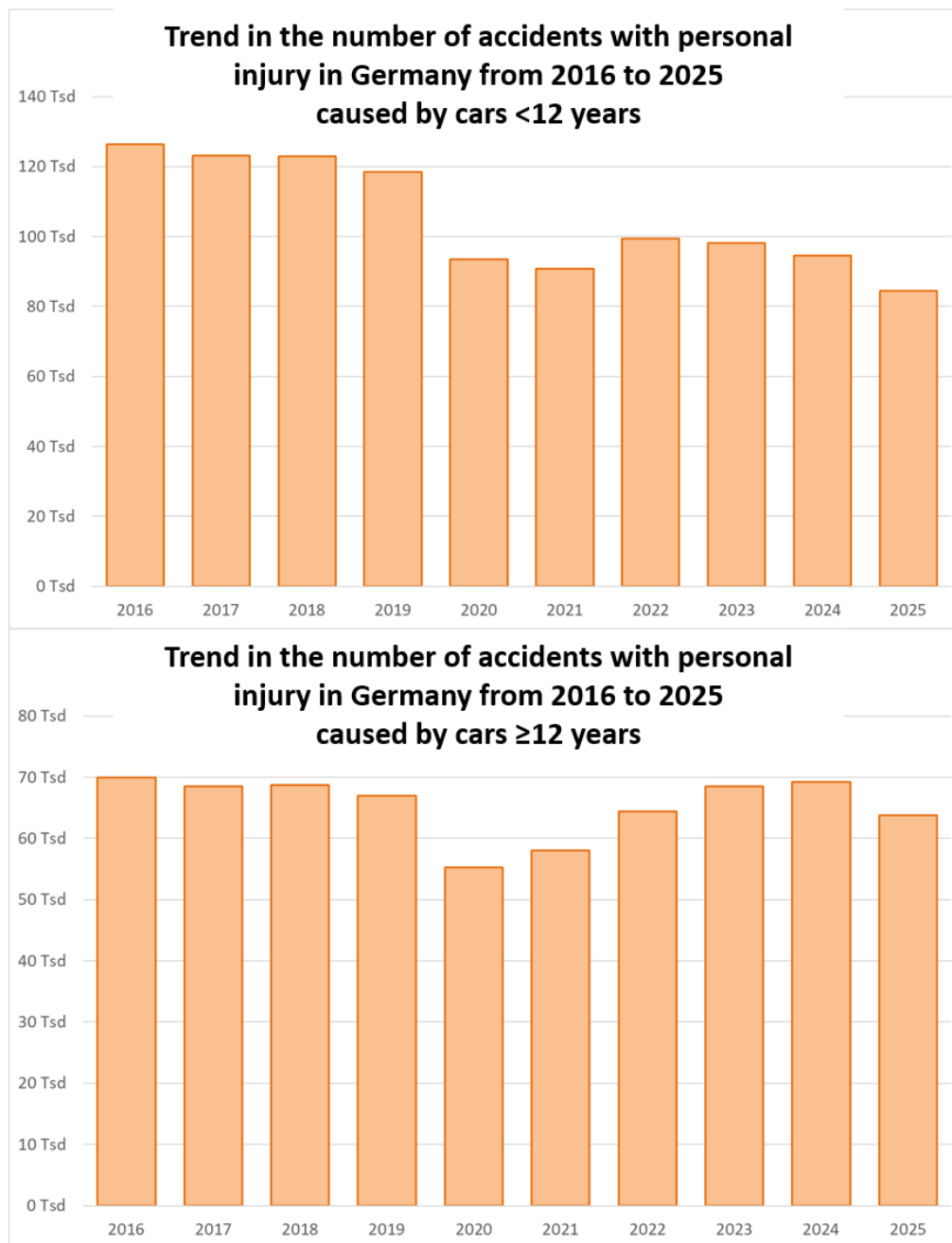
This is particularly apparent in the development of older passenger cars in the vehicle fleet and in accident occurrence. Over the past ten years, the absolute number of older passenger cars in the fleet has risen substantially; in this analysis, older passenger cars are considered from a vehicle age of twelve years onward.

Figure 74: Potential estimate - development of the fleet of younger and older passenger cars in Germany, 2016-2025



If this fleet growth alone were decisive for the development of accident occurrence, a corresponding increase in the absolute number of personal-injury accidents caused by older passenger cars would also be expected for this age group. This is not what the data show. Although the number of older passenger cars in the fleet has increased, the absolute number of personal-injury accidents caused by passenger cars in this age group has not increased correspondingly over the period under review.

Figure 75: Potential estimate - development in the number of road accidents involving personal injury in Germany, 2016-2025



Figures 74 and 75 are therefore to be read as time series within the respective age group. They are not primarily intended as a visual comparison of levels between younger and older passenger cars, but as a way of classifying how fleet size and accident frequency have developed over time within the same age group.

For younger passenger cars, despite a broadly stable fleet size, the period under review shows a clear decline in the absolute number of accidents involving personal injury caused

by these vehicles. For older passenger cars, the corresponding number of accidents has not increased despite the larger vehicle fleet; it remains approximately stable or declines slightly. This finding argues against transferring changes in the vehicle fleet directly to accident occurrence without further correction.

The frequency of accidents involving personal injury at a given vehicle age therefore depends not only on the number of vehicles in the fleet, but to a significant extent on the traffic exposure of the respective age group, i.e. on how frequently these vehicles are actually present in traffic.

For a defined vehicle age, this traffic exposure depends on two factors:

- the number of passenger cars in the fleet at the respective vehicle age or within the respective age group; and
- the average annual mileage of passenger cars of that vehicle age or age group.

The total annual mileage of passenger cars at the respective vehicle age can be calculated from these two quantities. This total mileage can be interpreted as a measure of traffic exposure. It describes not only how many vehicles of an age group exist, but also the extent to which those vehicles are actually used in traffic. For estimating accident occurrence, this measure is therefore more informative than the vehicle fleet alone.

Accordingly, total mileage can be interpreted as traffic exposure or the frequency of traffic participation. It correlates strongly with the frequency of accident causation.

Figure 76: Potential estimate - annual mileage of younger and older passenger cars in Germany, 2016-2025

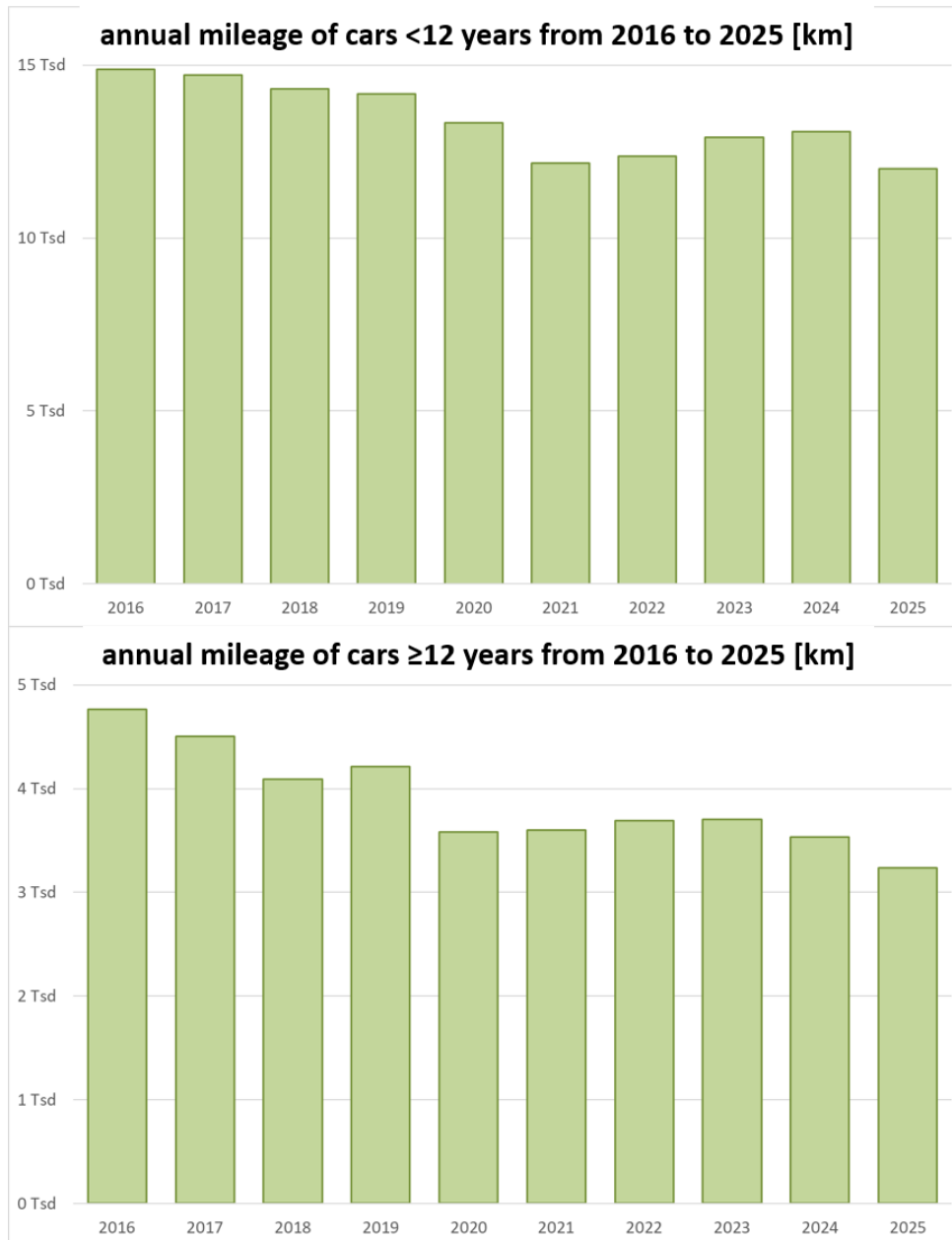
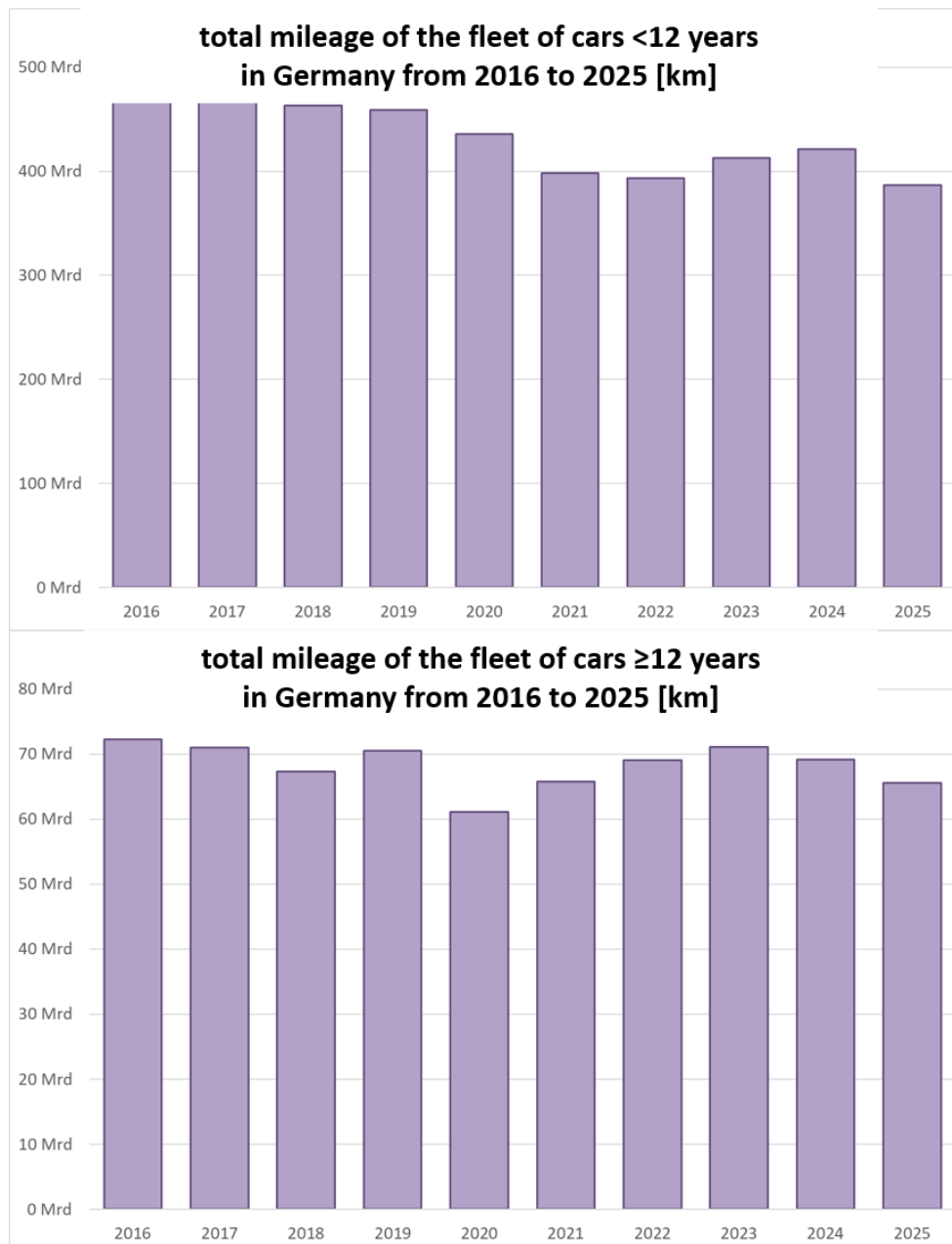


Figure 77: Potential estimate - total mileage of younger and older passenger cars in Germany, 2016-2025



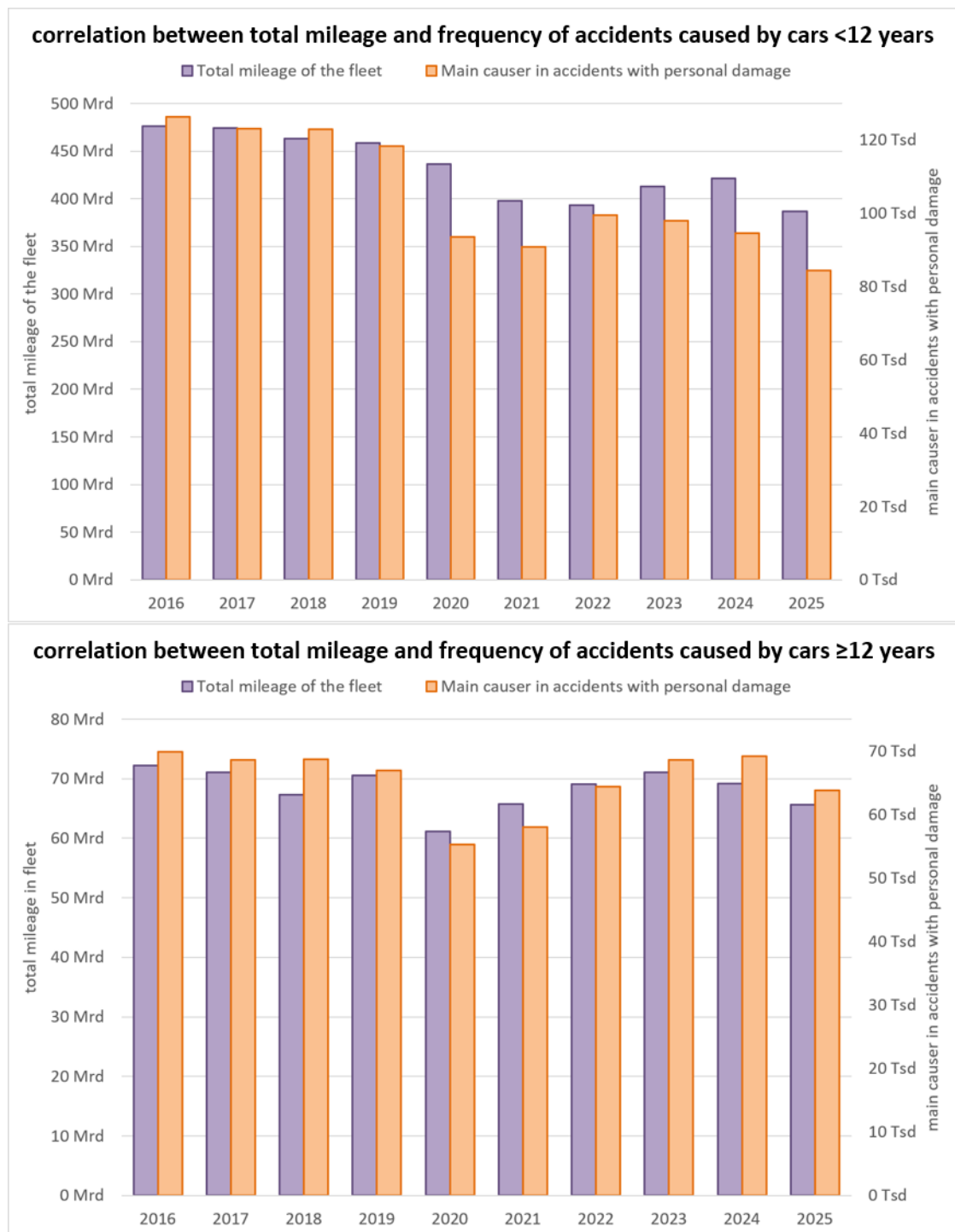
The comparison between total mileage by age group and year, on the one hand, and the frequency with which passenger cars are primary causers of personal-injury accidents by age group and year, on the other, shows a very high correlation. For passenger cars under 12 years of age the correlation is $r = 0.914$; for passenger cars aged 12 years and older it is $r = 0.852$. The correlations relate to the development over time within the respective age group. They therefore show that changes in total mileage within the group of younger or older passenger cars are closely linked to changes in the respective accident frequency. A

direct comparison of absolute levels between younger and older passenger cars is not necessary for this purpose.

For the following model, it is therefore assumed that the number of primary causers of accidents involving personal injury within an age group is approximately proportional to the total mileage of that age group. This assumption goes beyond the finding of a high correlation: the correlation initially shows only a close linear relationship, but does not automatically establish a proportional relationship without an additive absolute term. A relationship through the origin is, however, technically plausible here because total mileage is understood as an exposure variable. Without mileage there is no traffic participation and therefore no mileage-related risk of causing a personal-injury accident as the primary causer. A positive absolute term would, by contrast, imply that a certain number of accident causations would be expected even without traffic exposure, which would not be meaningful in substantive terms.

The proportionality assumption therefore corresponds to the assumption of an approximately constant accident risk per unit of mileage within the age group and forecast period considered. It is a modelling simplification because further influencing variables such as usage patterns, driver characteristics or general developments in road safety are not modelled separately. The high empirical correlation between total mileage and accident frequency supports this assumption, but does not replace the substantive justification for proportional modelling.

Figure 78: Potential estimate - correlation between total mileage and accident frequency for younger and older passenger cars in Germany, 2016-2025



The considerations above can be summarised as follows:

- Total mileage is calculated as the product of the number of vehicles in the fleet and the average mileage per vehicle at the respective vehicle age or in the respective age group.
- Assuming a constant accident risk per unit of mileage, a change in total mileage leads to an approximately proportional change in the number of primary causers of accidents involving personal injury within the same age group.
- A mere change in fleet size can be transferred approximately proportionally to accident frequency only if average mileage per vehicle remains unchanged. If mileage changes, fleet development must be corrected accordingly using total mileage.
- For the subsequent scenarios, the analysis therefore uses not only the development of the passenger-car fleet, but the age-dependent total mileage as the central exposure variable. This avoids interpreting the increase or decrease of individual fleet groups directly and unadjusted as a corresponding increase or decrease in accident occurrence.

7.2 Presentation of the forecast scenarios for 2035 in terms of fleet size and mileage

On the basis of the model developed and the empirical relationships described above, scenario calculations for the year 2035 are carried out below. The objective is not to produce a secure forecast of future accident occurrence, but to estimate how different assumptions regarding the development of the passenger-car fleet and annual mileage could affect the expected number of personal-injury accidents caused by passenger cars.

As shown above, the number of personal-injury accidents caused by passenger cars expected in 2035 does not depend solely on the development of the vehicle fleet. The decisive factor is instead the total mileage of the respective age group, which is derived from the number of vehicles and their average annual mileage per vehicle. For the scenario calculation, both fleet development and the development of annual mileage are therefore taken into account.

The future development of the passenger-car fleet is subject to considerable uncertainty. This applies in particular to the age group of older vehicles, because changes in HU/PTI inspection intervals can themselves have feedback effects on the vehicle fleet. Shorter inspection intervals may lead to defects being detected and rectified more often. This can increase the running costs of older vehicles and thus influence the decision whether to continue using a vehicle or to deregister it. For this reason, the study does not rely on a single forecast, but considers three scenarios.

Scenario A: For 2035 it is assumed that the passenger-car fleet and the average annual passenger-car mileage in each age group continue linearly in line with the observed time-series trend from 2016 to 2025. This scenario therefore represents a pure trend extrapolation without additional assumptions regarding possible feedback effects of changed HU/PTI inspection intervals on the vehicle fleet.

Scenario B: For passenger cars under 12 years of age, it is assumed that both the fleet and the average annual mileage continue linearly in line with the 2016-2025 time series. For passenger cars aged 12 years and older, it is also assumed that average annual mileage continues linearly in line with the previous time-series development. However, the fleet growth in this age group is reduced compared with Scenario A: it is assumed that the increase in the passenger-car fleet aged 12 years and older is only half as high as under a purely linear extrapolation.

Scenario C: For passenger cars under 12 years of age, it is again assumed that both the fleet and average annual mileage continue linearly in line with the 2016-2025 time series. For passenger cars aged 12 years and older, average annual mileage is assumed to continue linearly in line with the previous time-series development. By contrast, the fleet size of this age group is kept constant at the 2025 level. This scenario therefore assumes no further growth in the fleet of older passenger cars up to 2035.

The assumptions in Scenarios B and C, according to which the fleet growth of passenger cars aged 12 years and older is weakened or ceases entirely compared with previous development, are based on the consideration that changed HU/PTI inspection intervals can also influence usage behaviour and the economic attractiveness of older vehicles. It should be emphasised that none of the scenarios assumes a fundamental rejuvenation of the passenger-car fleet relative to 2025. Scenarios B and C merely limit the further growth of the age group of passenger cars aged 12 years and older. It is therefore not assumed that older vehicles will disappear from the fleet on a large scale in the short term, but only that their previous fleet growth could weaken or cease to continue under changed framework conditions.

The following figures show the scenarios for 2035. Figures 79 and 80 show the assumed development of the passenger-car fleet in the age classes considered, while Figures 81 and 82 show the corresponding assumptions regarding annual mileage. Figure 80 illustrates the different assumptions for the development of the fleet of older vehicles under Scenarios A, B and C.

Figure 79: Potential estimate - forecast for the fleet of younger passenger cars in 2035 under Scenarios A, B and C

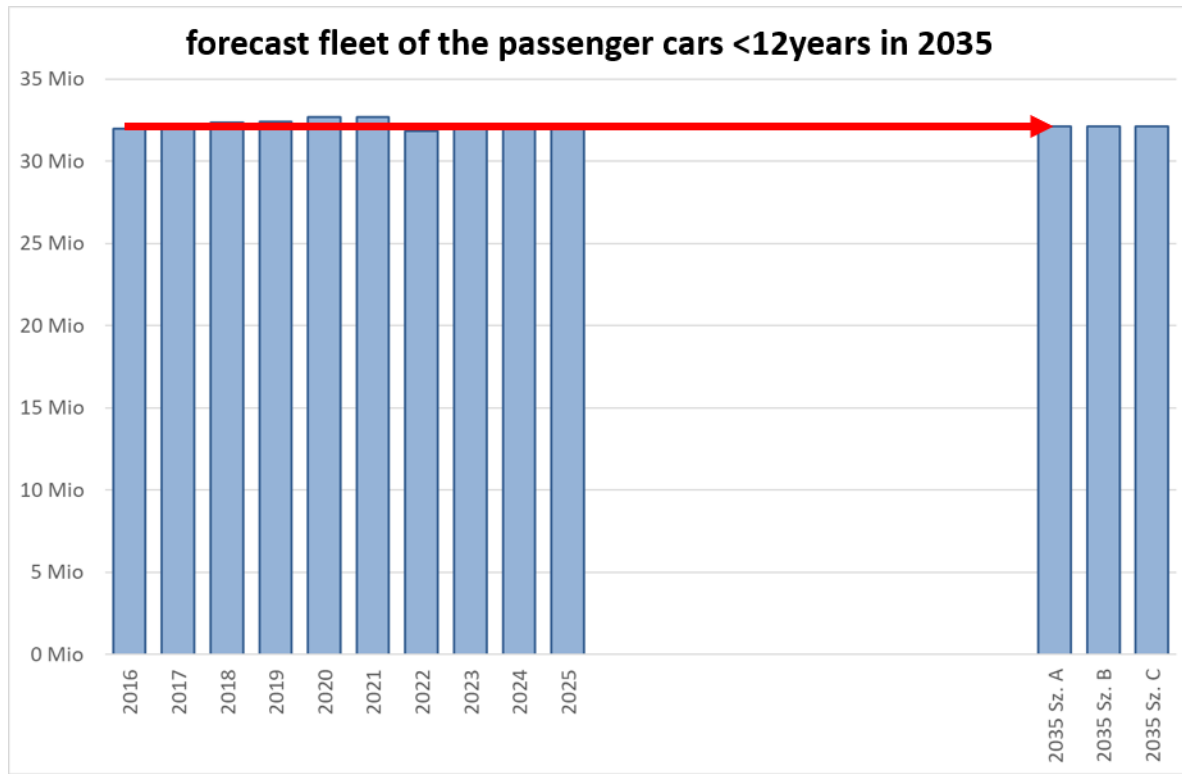


Figure 80: Potential estimate - forecast for the fleet of older passenger cars in 2035 under Scenarios A, B and C

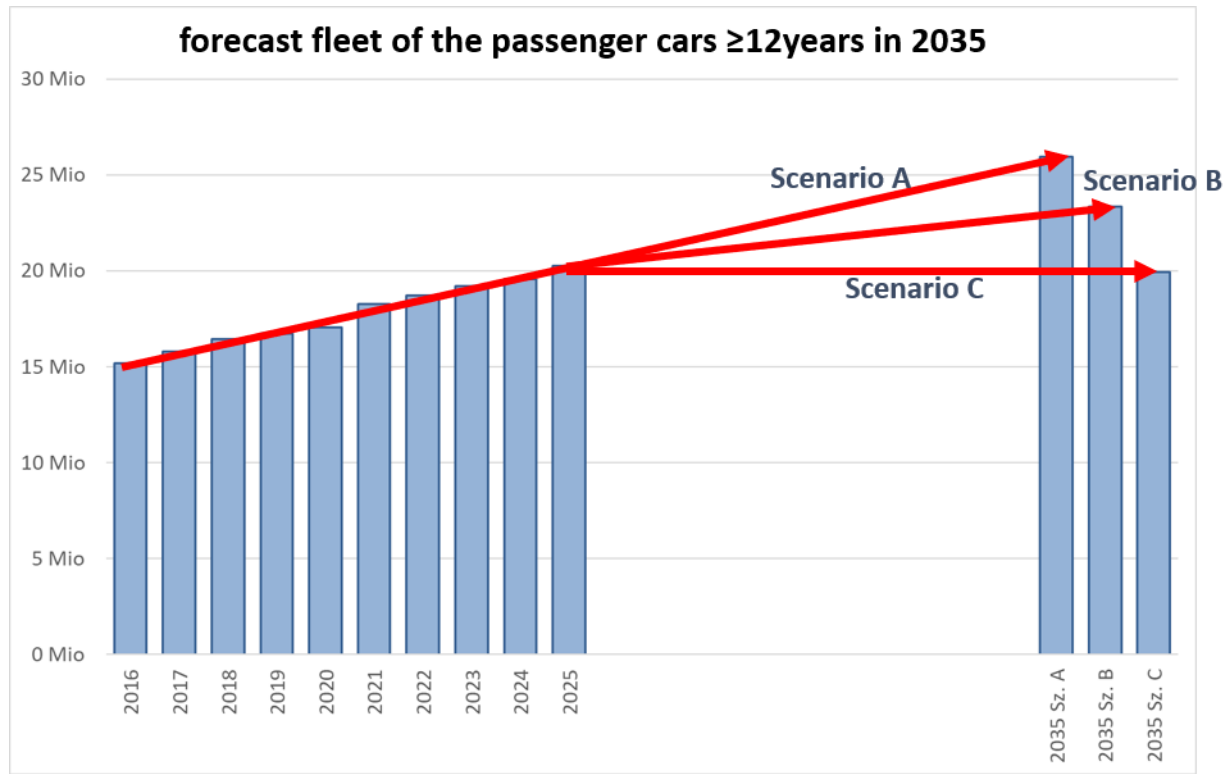


Figure 81: Potential estimate - forecast for annual mileage of younger passenger cars in 2035 under Scenarios A, B and C

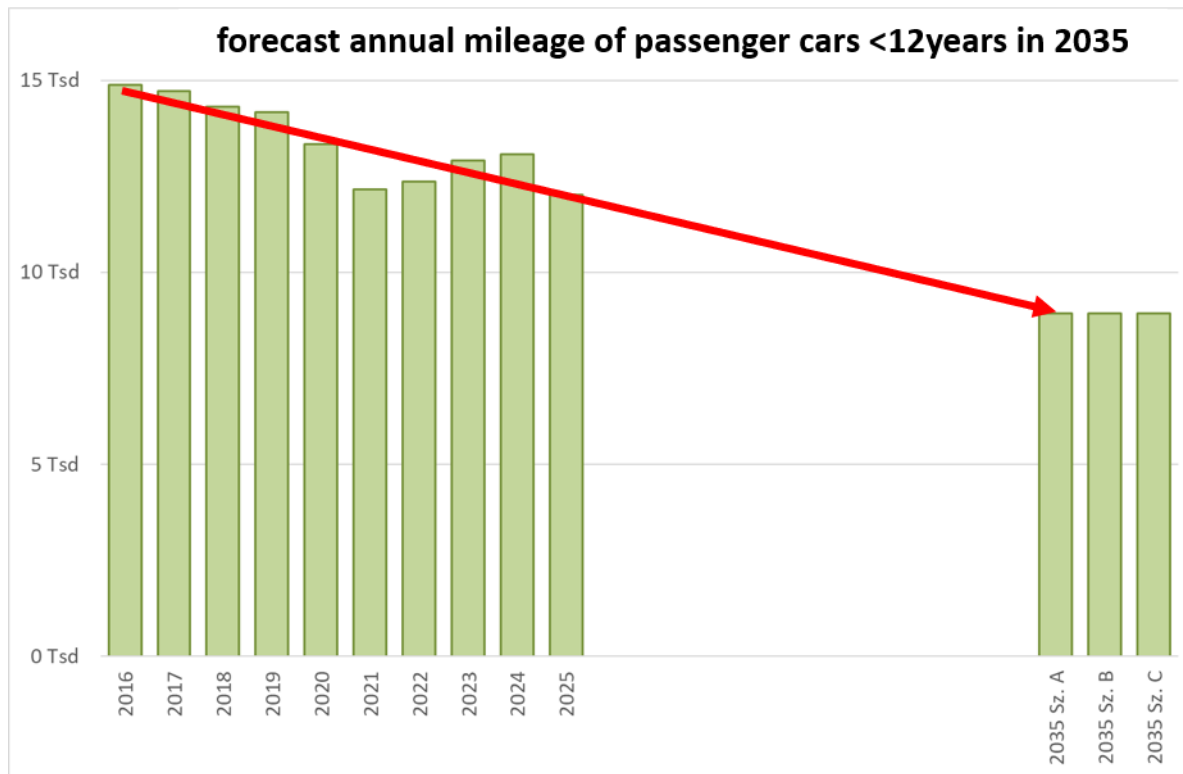
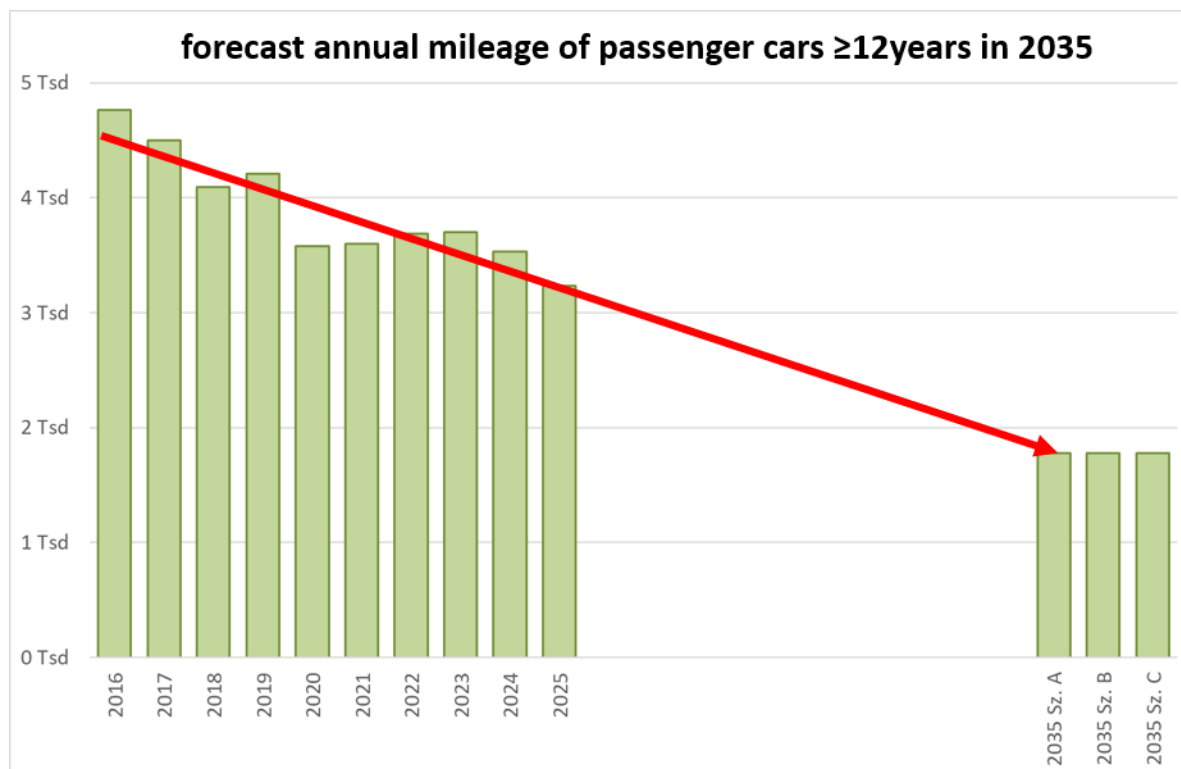


Figure 82: Potential estimate - forecast for annual mileage of older passenger cars in 2035 under Scenarios A, B and C



7.3 FORSA survey on ownership, use and maintenance of older vehicles

The DAT Report 2025 reports average annual maintenance and repair costs of more than EUR 600 for passenger cars aged six years and older, with an average of around one repair per vehicle every two years. This suggests that repairs are often carried out in temporal connection with the regular periodic technical inspection due every two years. A shorter HU/PTI interval could therefore lead to major or dangerous defects being detected more frequently and consequently rectified earlier. Especially for older vehicles, this may increase running costs and shorten their economically viable useful life.

As a consequence of shorter HU/PTI intervals and the associated more frequent repairs to rectify defects, it is plausible that older vehicles could be deregistered more often or replaced by younger vehicles. Since the magnitude of this effect cannot be quantified robustly, it is not modelled as a fixed forecast. Instead, Scenarios B and C consider two graded sensitivity assumptions: reduced fleet growth for older passenger cars compared with previous development, and a complete absence of further fleet growth in this age group.

To classify this relationship, the study commissioned a FORSA consumer survey among owners of older passenger cars. The survey focused in particular on maintenance, repair and disposal/recycling of passenger cars more than 12 years old.

The results initially show that the periodic technical inspection plays a relevant role in workshop and repair behaviour for older passenger cars. Three out of four vehicle owners surveyed stated that they had visited a motor-vehicle workshop with their older passenger car in the past four years because of the periodic technical inspection. This supports the assumption that the PTI is often a trigger for technical inspection, maintenance and, where necessary, repair in older vehicles.

At the same time, the survey results indicate that repair costs for older vehicles have a significant influence on the decision about their continued use. If the financial cost of a necessary repair exceeds the value of the vehicle, many owners tend not to have the vehicle repaired, but to hand it over for recycling. Only around one in four vehicle owners state that they would nevertheless have the vehicle repaired in such a case. It therefore appears plausible that more frequent HU/PTI inspections of older vehicles could lead not only to earlier defect rectification, but in some cases also to earlier deregistration.

The information regarding a possible next vehicle purchase also does not suggest that older vehicles leaving the fleet would predominantly be replaced by very old vehicles again. Among the surveyed owners of passenger cars more than 12 years old, 11% would be most likely to choose a new car for their next vehicle purchase, 13% a one-year-old car, 38% a used car between two and six years old, 14% a used car between six and twelve years old, and 6% a used car more than 12 years old. For 9% of surveyed owners, no further car purchase is generally an option after giving up the old vehicle. These responses support the assumption that deregistration of older vehicles can at least partly lead to a shift into younger vehicle segments or to an exit from the passenger-car fleet.

At the same time, it must be taken into account that the average age of passenger cars at the time of final deregistration has risen in recent years and is currently above 18 years. This tendency for vehicles to remain in the fleet for longer, thereby increasing the average age of the vehicle fleet, is also referred to as the Havana effect. It indicates that older vehicles may continue to represent a relevant and growing group within the passenger-car fleet. For precisely this reason, the scenarios do not assume abrupt shifts in the fleet, but only different assumptions as to whether, and to what extent, the previous growth in older passenger cars will continue up to 2035.

In the age range from 12 to 25 years, final deregistration may also be linked to the non-issuance of a PTI sticker. Vehicles that do not receive a valid inspection sticker and whose repair is no longer carried out for economic reasons no longer participate in traffic. This creates a plausible relationship between PTI inspection intervals, repair decisions and the number of vehicles deregistered each year. Since the strength of this effect cannot be robustly quantified, it is not modelled as a fixed forecast but represented through Scenarios B and C as a sensitivity assumption.

7.4 Development of accident numbers in the scenarios

On the basis of the scenario values for 2035 for passenger-car fleet size and annual mileage, scenario-based estimates can be derived for road accidents involving personal injury caused by passenger cars. The basis is the previously justified assumption that accident frequency within an age group is approximately proportional to the total mileage of that age group. Total mileage is derived from the passenger-car fleet and the average annual mileage per vehicle. For Scenarios A, B and C, these quantities are considered separately for the age groups "< 12 years" and ">= 12 years".

The lower fleet growth assumed in Scenario B for passenger cars aged 12 years and older leads, compared with Scenario A, to a correspondingly lower scenario value for personal-injury accidents caused by this age group. Compared with the linear extrapolation in Scenario A, Scenario B results in a reduction of about 10%. In Scenario C, in which no further fleet growth beyond 2025 is assumed for the ">= 12 years" age group, the corresponding scenario value is about 20% below the value in Scenario A.

The corresponding scenario-based accident numbers for 2035 are shown for passenger cars under 12 years of age in Figure 83 and for older passenger cars in Figure 84.

Figure 83: Potential estimate - scenario values for personal-injury accidents caused by younger passenger cars in 2035 under Scenarios A, B and C

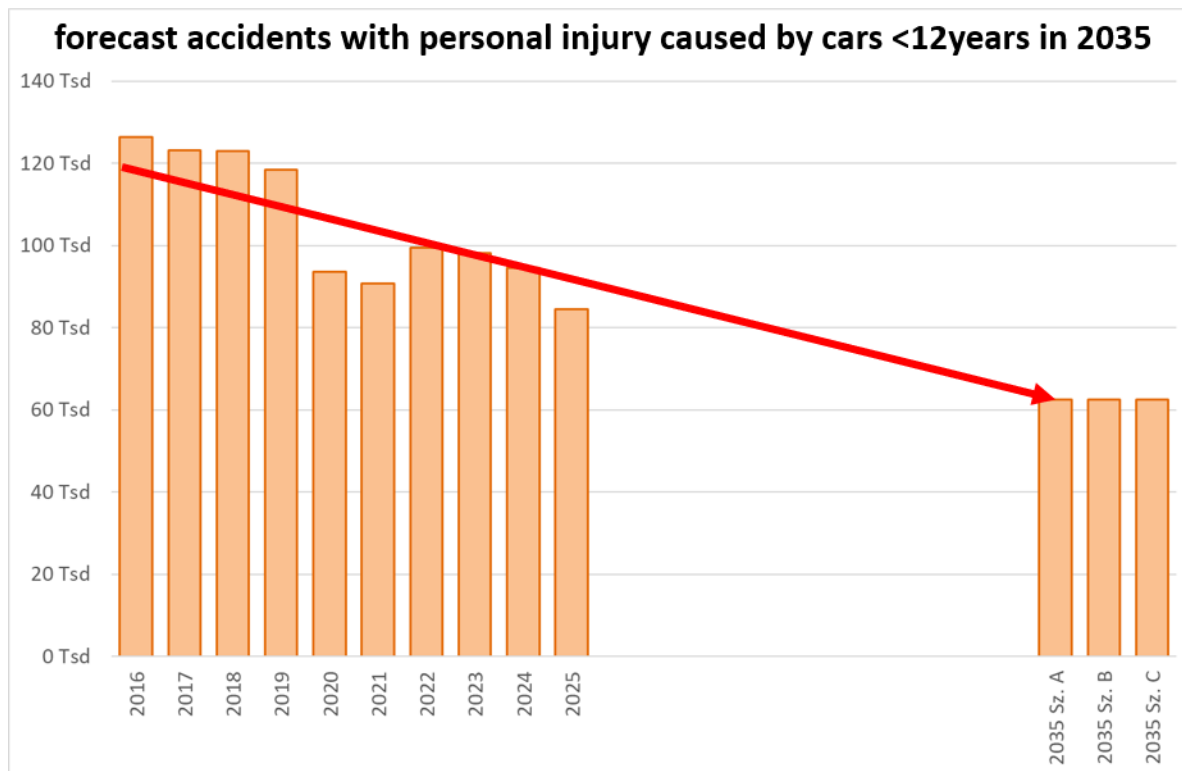
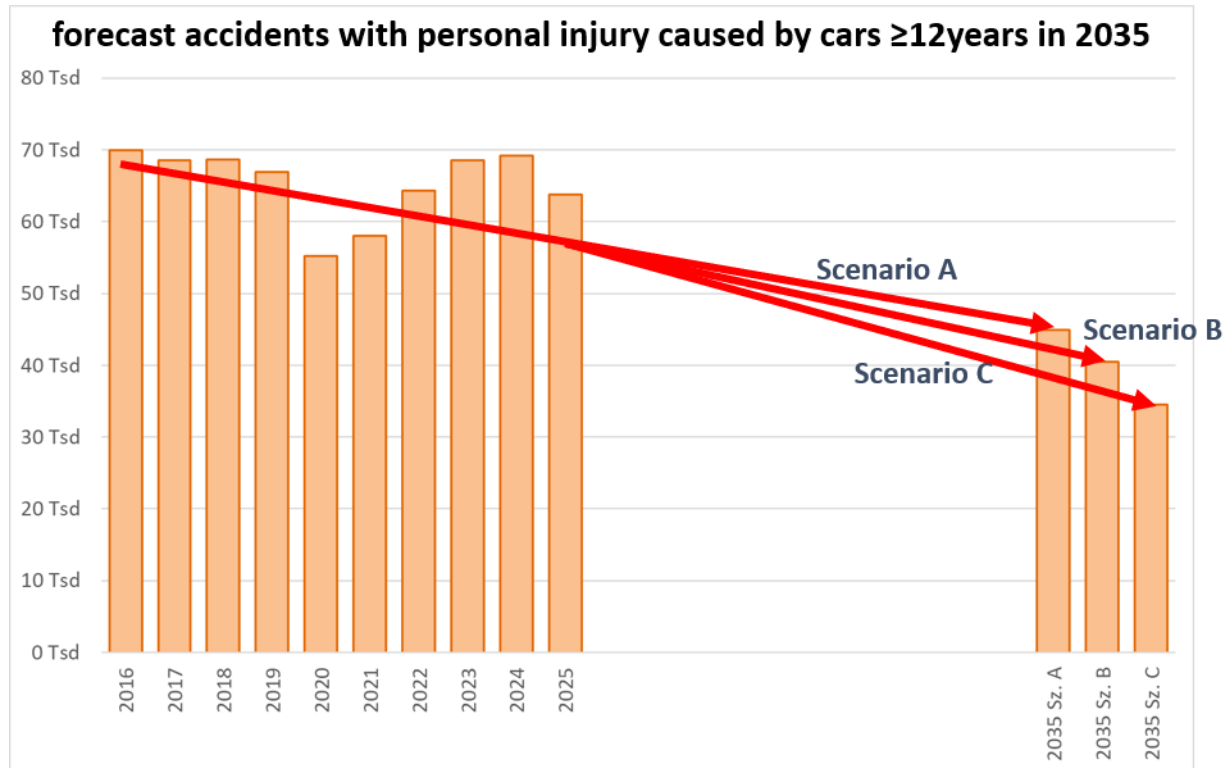


Figure 84: Potential estimate - scenario values for personal-injury accidents caused by older passenger cars in 2035 under Scenarios A, B and C



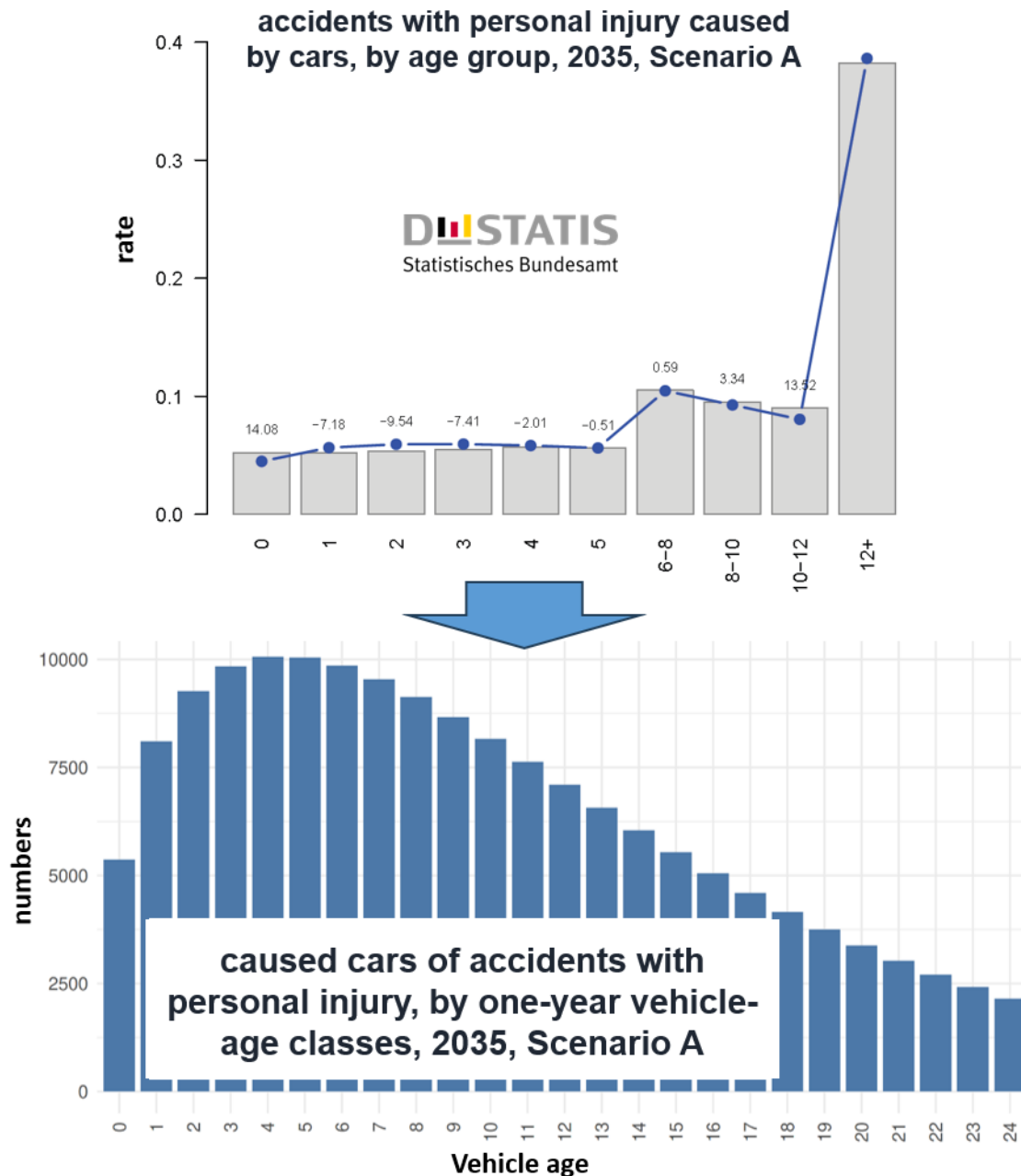
7.5 Distribution of passenger-car primary causers by one-year age classes

For the further calculation, however, it is not sufficient to divide the data into the two age groups "< 12 years" and ">= 12 years". What is needed is a distribution of accident numbers by vehicle age in one-year age classes. The accident data available from Destatis, however, list only vehicle ages 0 to 5 individually; older vehicles are shown in cumulative age groups. In order to derive scenario-dependent accident numbers for 2035 broken down by individual vehicle age, the accident numbers of the age groups reported by Destatis were first extrapolated linearly to 2035 on the basis of the 2010 to 2024 time series. For the group of vehicles aged 12 years and older, the scenario-specific adjustments were then made: no reduction in Scenario A, a 10% reduction in Scenario B and a 20% reduction in Scenario C. Finally, to convert the cumulative age groups into accident numbers for vehicle age in one-year classes, a Weibull distribution was fitted. On this basis, the annual accident numbers by vehicle age were modelled.

To check the plausibility of the model fit, the annual values estimated with the Weibull distribution were then recombined according to the Destatis age groups and compared with the previously extrapolated group values. The good agreement shows that the modelled age distribution represents the specified group values with sufficient accuracy.

The result of this step is a scenario-specific distribution of personal-injury accidents caused by passenger cars in 2035, broken down by vehicle age in one-year classes. This procedure was carried out separately for each of Scenarios A, B and C and for each accident category reported by Destatis, namely personal-injury accidents overall, accidents with slight injuries, accidents with serious injuries and accidents with fatalities.

Figure 85: Potential estimate - conversion of the Destatis passenger-car age-group distribution into vehicle age in years by modelling with the Weibull distribution

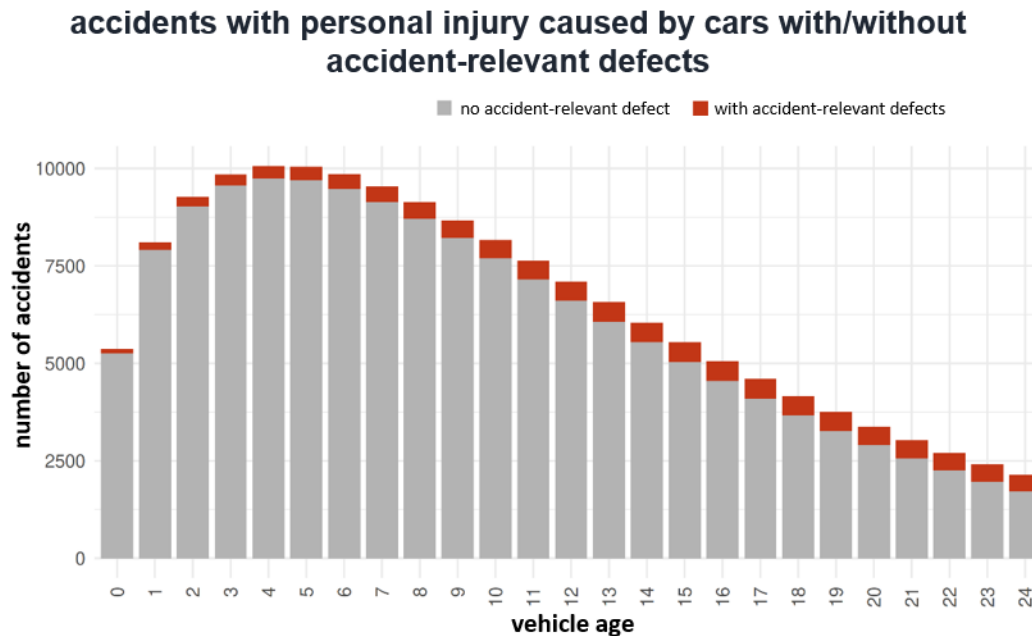
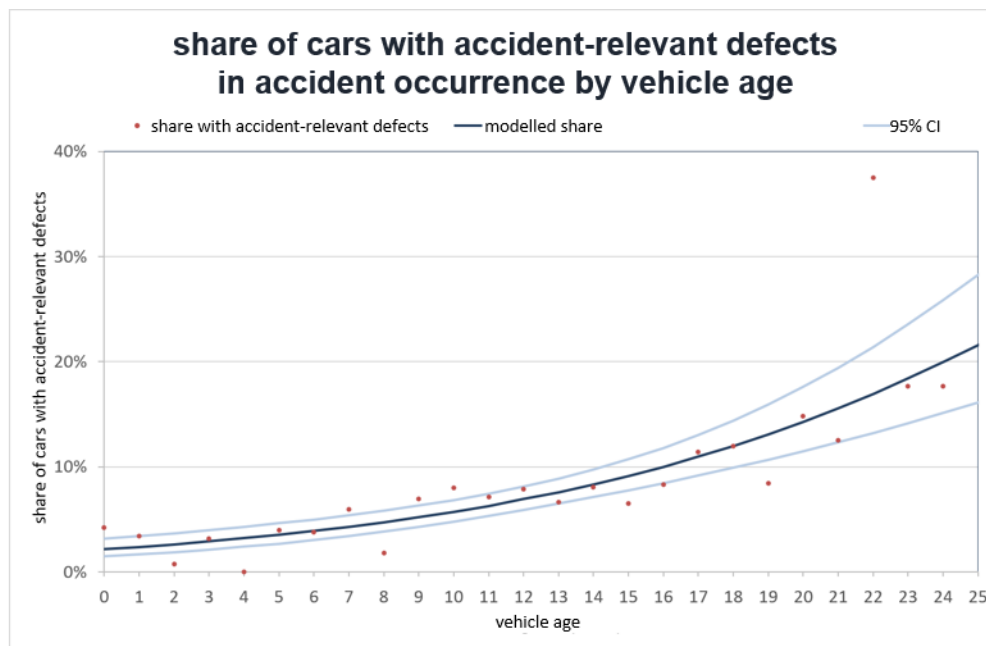


The further methodological procedure is presented below using Scenario A and personal-injury accidents as an example.

7.6 Determining the share of accident-relevant defects among passenger-car primary causers

The age-dependent shares of accident-involved passenger cars with accident-relevant technical defects determined in Chapter 5.5 were then applied to the modelled age distribution of road accidents caused by passenger cars. For each vehicle age, this made it possible to calculate which share of personal-injury accidents under Scenario A is attributable to vehicles with accident-relevant technical defects.

Figure 86: Potential estimate - application of the share of passenger cars with accident-relevant technical defects to the age distribution of passenger-car-caused personal-injury accidents under Scenario A



This produces, for each vehicle age, a division of the modelled accident numbers into two groups: accidents in which the causing passenger car had accident-relevant technical defects, and accidents in which the primary-causing passenger car had no accident-relevant technical defects.

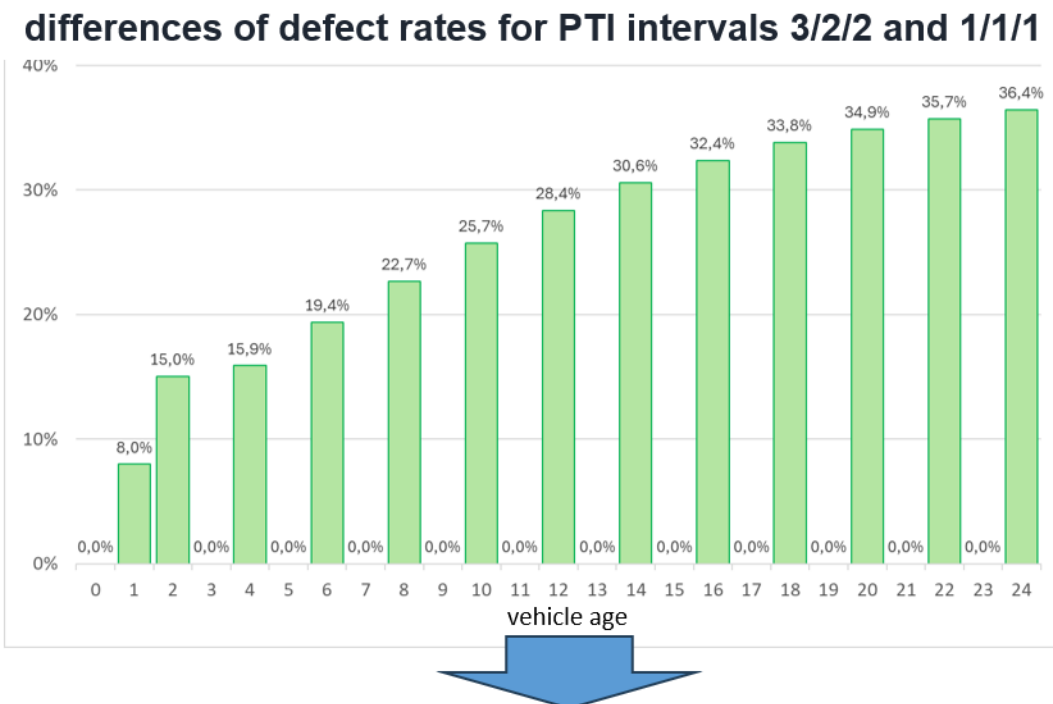
7.7 Effect of shortened HU/PTI intervals on accident causation

The central modelling assumption for this analytical step is that a reduction in the defect rate, i.e. in the share of vehicles with defects, has a proportional effect on the number of accidents caused by defects. For this purpose, the age-dependent accident numbers involving accident-relevant technical defects are combined with the age-dependent reduction potentials from the periodic reset model. In simplified terms, the model assumes that if a different HU/PTI interval reduces the share of vehicles with major or dangerous defects by a certain percentage at a given vehicle age, the number of accidents with accident-relevant technical defects at that vehicle age is reduced by the same proportion.

This assumption is necessary in order to transfer the modelled change in defect probabilities to accident occurrence. It is plausible as a potential-estimate assumption, but it does not claim to reproduce the causality of every individual accident. The model therefore does not predict exact numbers of preventable accidents; instead it estimates a plausible reduction corridor based on the available empirical relationships and modelling assumptions.

The model can be applied to different inspection-interval schemes. In the study, the annual HU/PTI from first registration continues to be used only as a comparison scenario. The main analytical interest lies in the ability to model a transition from the current HU/PTI interval to annual inspections from freely selectable vehicle ages onward.

Figure 87: Potential estimate - effect of a shortened HU/PTI interval on passenger-car-caused personal-injury accidents with accident-relevant technical defects, Scenario A



reduction potential for accidents with personal injury caused by cars after implementation of annual PTI, 2035, scenario A

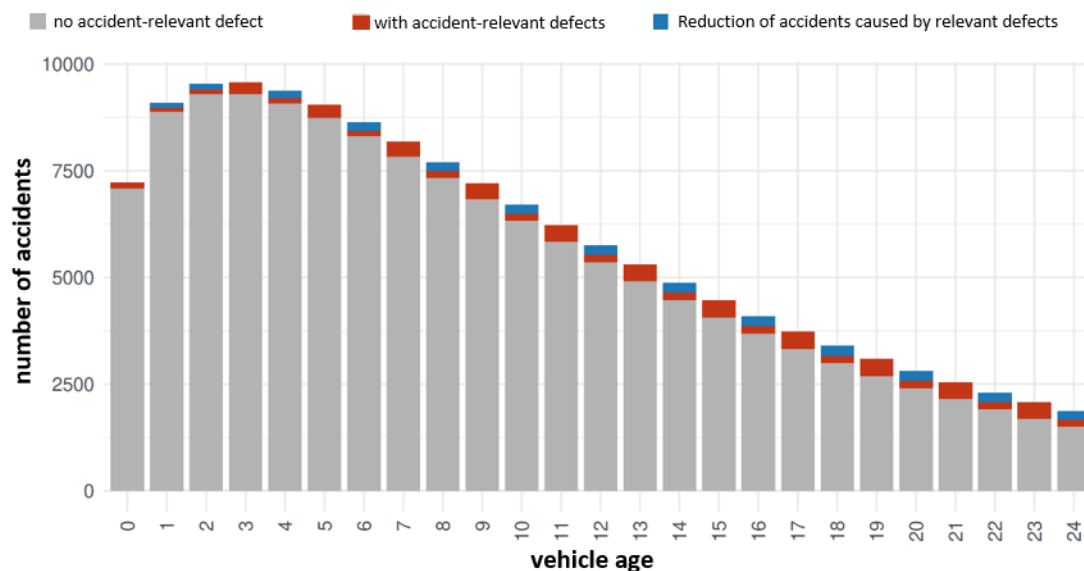


Table 11 illustrates, by way of example, for vehicle ages up to 8 years under Scenario A and for the accident category "accidents involving personal injury", how the potential number of preventable accidents was derived from the modelled number of passenger car

(PC)–caused accidents, the proportion of accident-relevant technical defects, and the reduction potential of the defect probability.

Table 11: Potential assessment – Excerpt of the results for estimating the reduction potential for passenger car–caused accidents involving personal injury under Scenario A and PTI inspection intervals of 1/1/1, 3/1/1, and 3/2/1

Age	RTA with injuries caused by passenger cars, total	RTA with injuries caused by passenger cars with accident-relevant defects	Reduction potential in %	Reduction in RTA with injuries caused by passenger cars with accident-relevant defects	PTI interval 1/1/1/... (annual)		PTI interval 3/1/1/... (annual from year 4)		PTI interval 3/2/1/... (annual from year 6)	
0	4.135	89	0,0%	0	x	0		0		0
1	6.265	149	54,2%	81	x	81		0		0
2	7.192	189	64,4%	122	x	122		0		0
3	7.669	222	0,0%	0	x	0	x	0	x	0
4	7.873	252	58,9%	148	x	148	x	148		0
5	7.889	278	0,0%	0	x	0	x	0	x	0
6	7.770	302	58,8%	178	x	178	x	178	x	178
7	7.553	324	0,0%	0	x	0	x	0	x	0
8	7.266	343	58,5%	201	x	201	x	201	x	201

The first column indicates the respective vehicle age. The second column contains the modelled total number of passenger car–caused accidents involving personal injury projected for the year 2035. Based on the age-dependent proportion of accident-relevant technical defects, the third column derives the number of accidents in which the at-fault passenger car exhibited an accident-relevant technical defect.

The fourth column presents the reduction potential in defect probability, derived from the periodic reset model, relative to the current PTI inspection interval. This reduction potential is subsequently applied to the accident figures shown in the third column. The resulting modelled reduction in passenger car–caused injury accidents involving accident-relevant technical defects is presented in the fifth column.

The remaining columns indicate whether and to what extent this age-specific reduction potential becomes effective under different PTI inspection interval schemes. An "x" indicates that, for the respective vehicle age and inspection schedule, an additional or earlier periodic technical inspection is carried out compared with the current system. Consequently, the calculated reduction potential is applied. If no additional inspection occurs for that vehicle age compared with the current PTI schedule, no additional reduction potential is assumed for that inspection scheme.

The table demonstrates that the reduction potential does not occur uniformly across all vehicle ages. It arises only in those years in which the alternative PTI inspection schedule results in an earlier or additional inspection compared with the current 3/2/2 system. Furthermore, the absolute magnitude of the reduction potential depends on vehicle age, since both the number of passenger car–caused accidents and the proportion of accident-relevant technical defects were modelled as age-dependent variables. Consequently, the table provides the computational basis for the subsequent aggregation of reduction potentials across all vehicle ages.

The methodology described above for estimating the reduction potential of passenger car–caused accidents involving personal injury was then systematically applied to all combinations of scenario, accident category, and PTI inspection schedule. The analysis covered Scenarios A, B, and C, as well as the accident categories reported by the German Federal Statistical Office (Destatis): all accidents involving personal injury, fatal accidents, accidents involving seriously injured persons, and accidents involving slightly injured persons.

The following figures first present the modelled age distributions of passenger car drivers identified as the principal cause of accidents, differentiated by accident category and scenario. These age distributions form the basis of the calculations because both the proportions of accident-relevant technical defects and the reduction potentials derived from the reset model are applied as age-dependent parameters. For reasons of clarity, the figures are shown here in a reduced scale. Full-size versions are provided in Appendix 2 and the subsequent appendices.

Figure 88 presents the modelled age distributions of passenger cars identified as the principal cause of accidents, differentiated by accident category and scenario.

Figure 88: Potential estimate - reduction potential for passenger-car-caused road traffic accidents (RTA) with personal injury under Scenario A

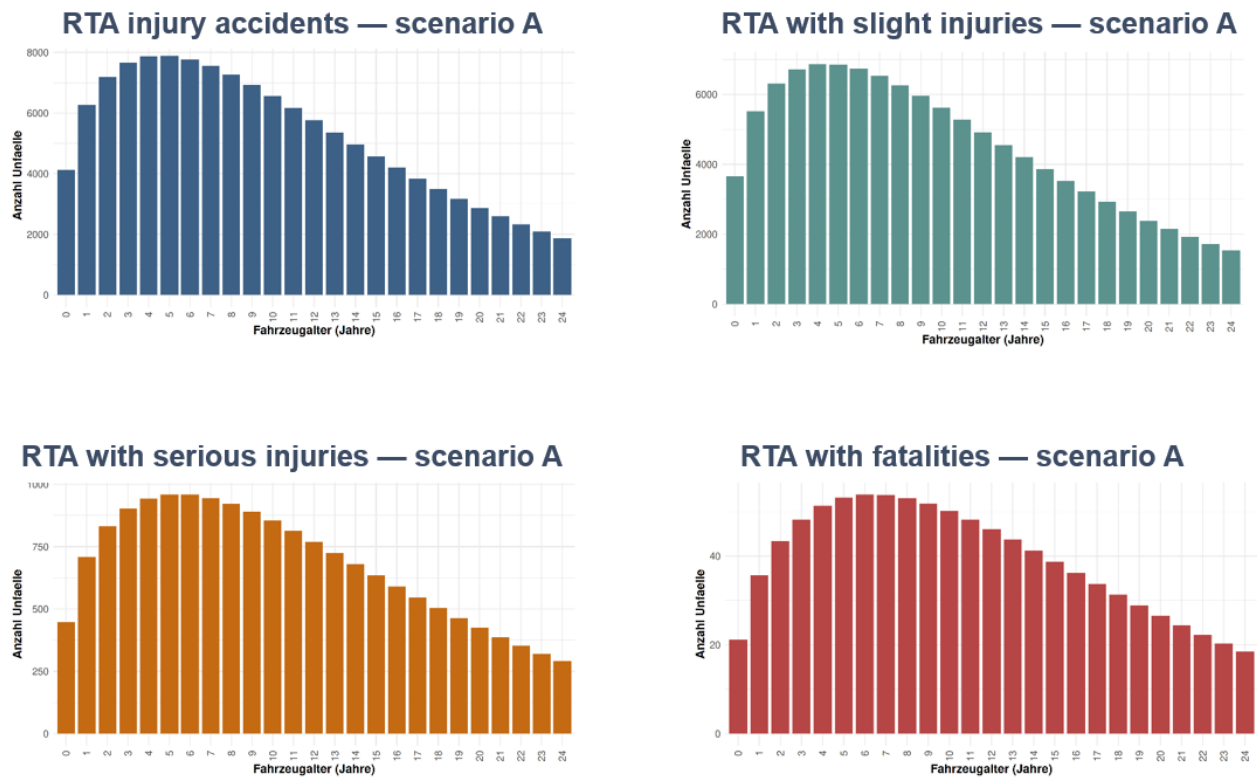


Figure 89: Potential estimate - reduction potential for passenger-car-caused road traffic accidents (RTA) with personal injury under Scenario B

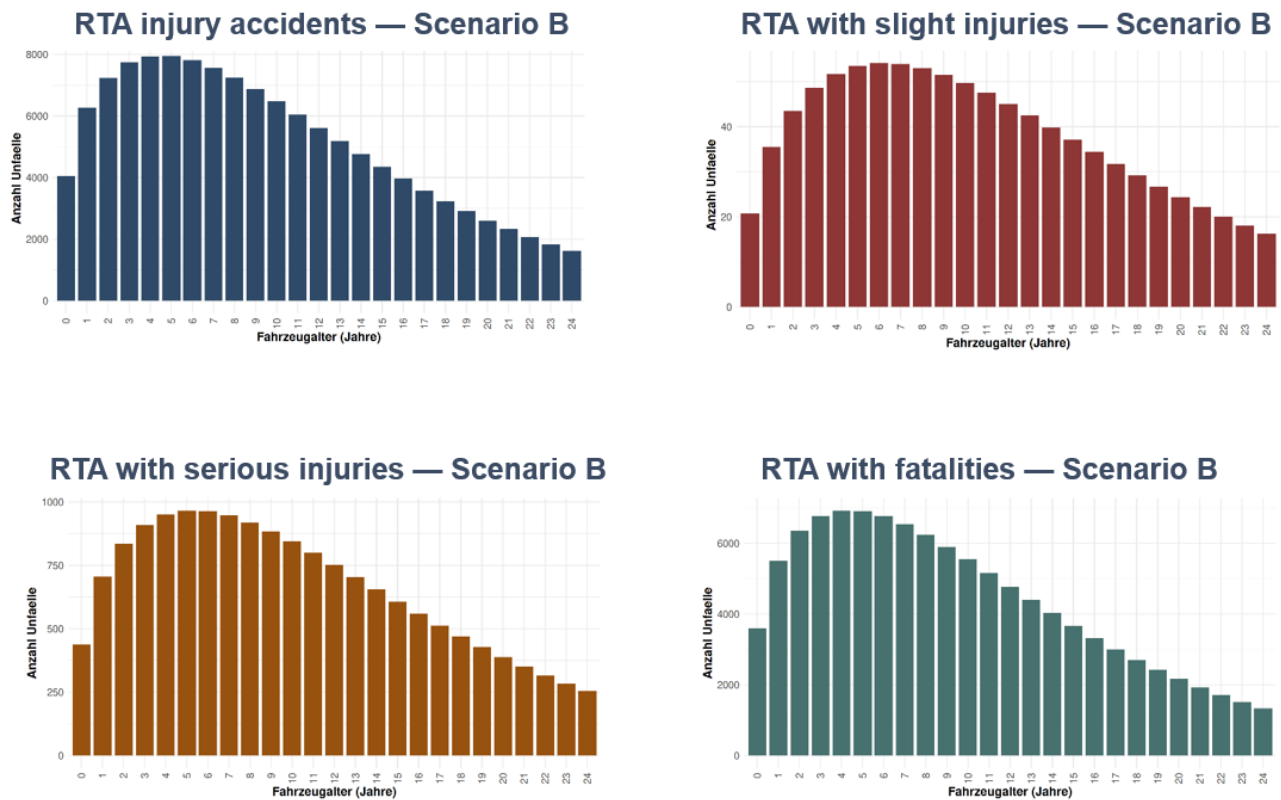
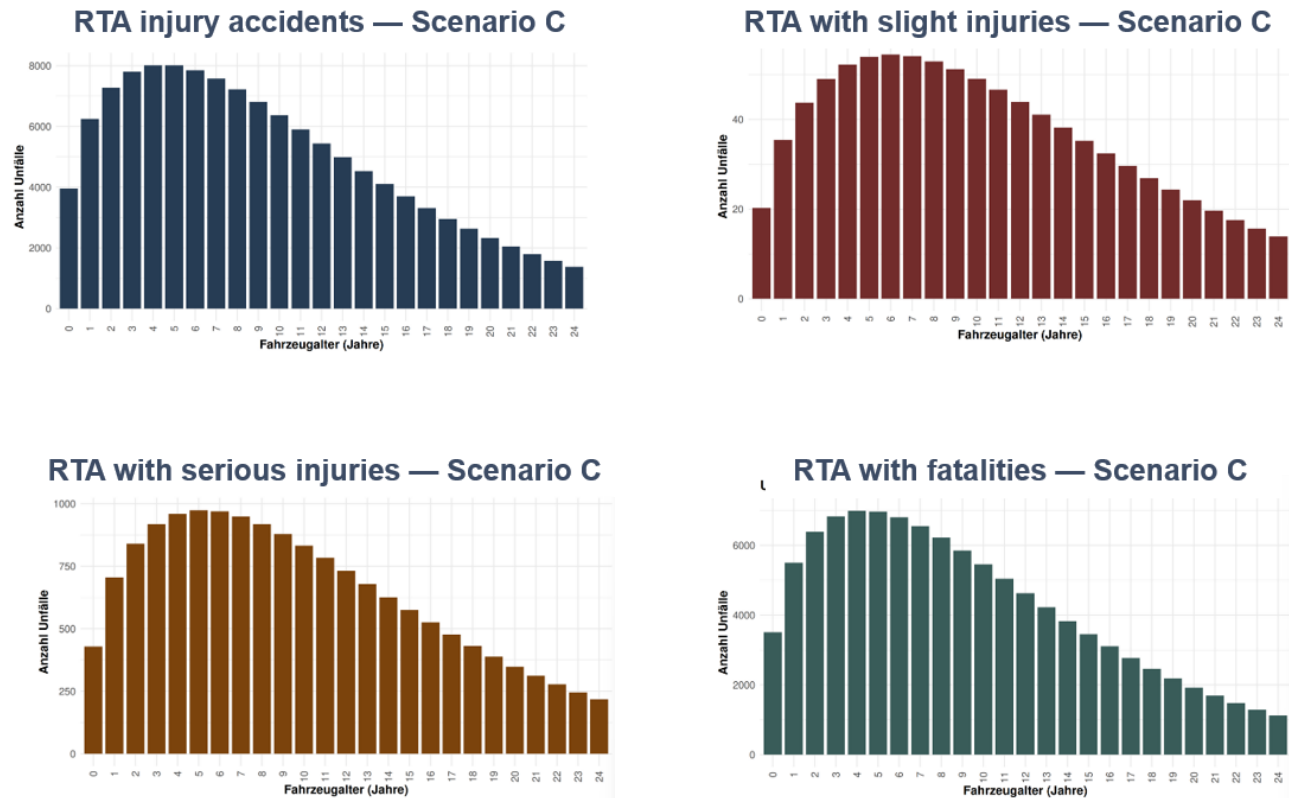


Figure 90: Potential estimate - reduction potential for passenger-car-caused road traffic accidents (RTA) with personal injury under Scenario C



The detailed breakdown of the age distributions, the corresponding proportions of accident-relevant technical defects, and the resulting reduction potentials by vehicle age is provided in Appendix 4 and the subsequent appendices for reasons of clarity.

Table 12 extends the calculation logic introduced in Table 11 to vehicle ages of up to 24 years. The example is based on passenger car-caused accidents involving personal injury in 2035 under the assumptions of Scenario A. It illustrates how the age-specific accident figures, the proportions of accident-relevant technical defects, and the reduction potentials derived from the periodic reset model are combined across all vehicle ages considered.

Table 12: Potential assessment – Example of the derivation of the reduction potential for passenger car–caused accidents involving personal injury in 2035 under Scenario A and a PTI inspection interval of 3/2/2/1 (annual from year 10)

reduction potential of accidents with personal injury caused by car in 2035, scenario A due to annual PTI						
age	RTA with injuries caused by passenger cars, total	RTA with injuries caused by passenger cars with accident-relevant defects	reduction potential in %	reduction in RTA with injuries caused by passenger cars with accident-relevant defects	PTI interval 3/2/2/1... (annual from year 10)	
0	4.135	89	0,0%	0		0
1	6.265	149	54,2%	81		0
2	7.192	189	64,4%	122		0
3	7.669	222	0,0%	0	x	0
4	7.873	252	58,9%	148		0
5	7.889	278	0,0%	0	x	0
6	7.770	302	58,8%	178		0
7	7.553	324	0,0%	0	x	0
8	7.266	343	58,5%	201		0
9	6.928	361	0,0%	0	x	0
10	6.556	376	58,1%	218	x	218
11	6.164	389	0,0%	0	x	0
12	5.762	400	57,6%	230	x	230
13	5.358	408	0,0%	0	x	0
14	4.959	415	57,2%	237	x	237
15	4.569	419	0,0%	0	x	0
16	4.193	422	56,7%	239	x	239
17	3.834	423	0,0%	0	x	0
18	3.493	421	56,4%	238	x	238
19	3.172	418	0,0%	0	x	0
20	2.871	413	56,1%	232	x	232
21	2.592	406	0,0%	0	x	0
22	2.332	398	55,9%	223	x	223
23	2.093	389	0,0%	0	x	0
24	1.874	378	56,1%	212	x	212
	130.365	8.585		2.558	1829	
total potential of accidents with personal injury					1,40%	

The table serves as an example of the subsequent aggregation process. For each vehicle age, the number of passenger car–caused accidents involving personal injury attributable to vehicles with accident-relevant technical defects is first determined. The age-specific reduction potential, derived from comparing the respective PTI inspection schedule with the current PTI inspection interval, is then applied to these accident figures. Finally, by summing the results across all vehicle ages, the overall model-based reduction potential is obtained for the respective combination of scenario, accident category, and PTI inspection schedule.

7.8 Results of the potential estimate

For the example presented in Table 12, a transition to annual periodic technical inspections (PTIs) from the 10th year of vehicle age onwards, corresponding to a 3/2/2/2/1 inspection schedule instead of the current 3/2/2/2/2 schedule, results in a modelled reduction of 1,829 passenger car–caused accidents involving personal injury under the assumptions of Scenario A. Relative to the total of 130,365 passenger car–caused injury accidents in this scenario, this corresponds to a relative reduction potential of 1.4% (see also Figure 95).

The same calculation was subsequently performed for all scenarios, accident categories, and PTI inspection schedules considered in this study. The resulting reduction potentials are summarized in the following figures. The scenario of annual PTIs from first registration is included solely as a reference scenario. The methodological focus of the model is to evaluate different transitions from the current PTI inspection schedule to annual inspections starting at freely selectable vehicle ages. All numerical values underlying the figures are provided in Appendix 2 and the subsequent appendices.

Figure 91: Potential estimate - overview of reduction potentials through annual 1/1/1 HU/PTI inspection interval in 2035 under Scenarios A, B and C

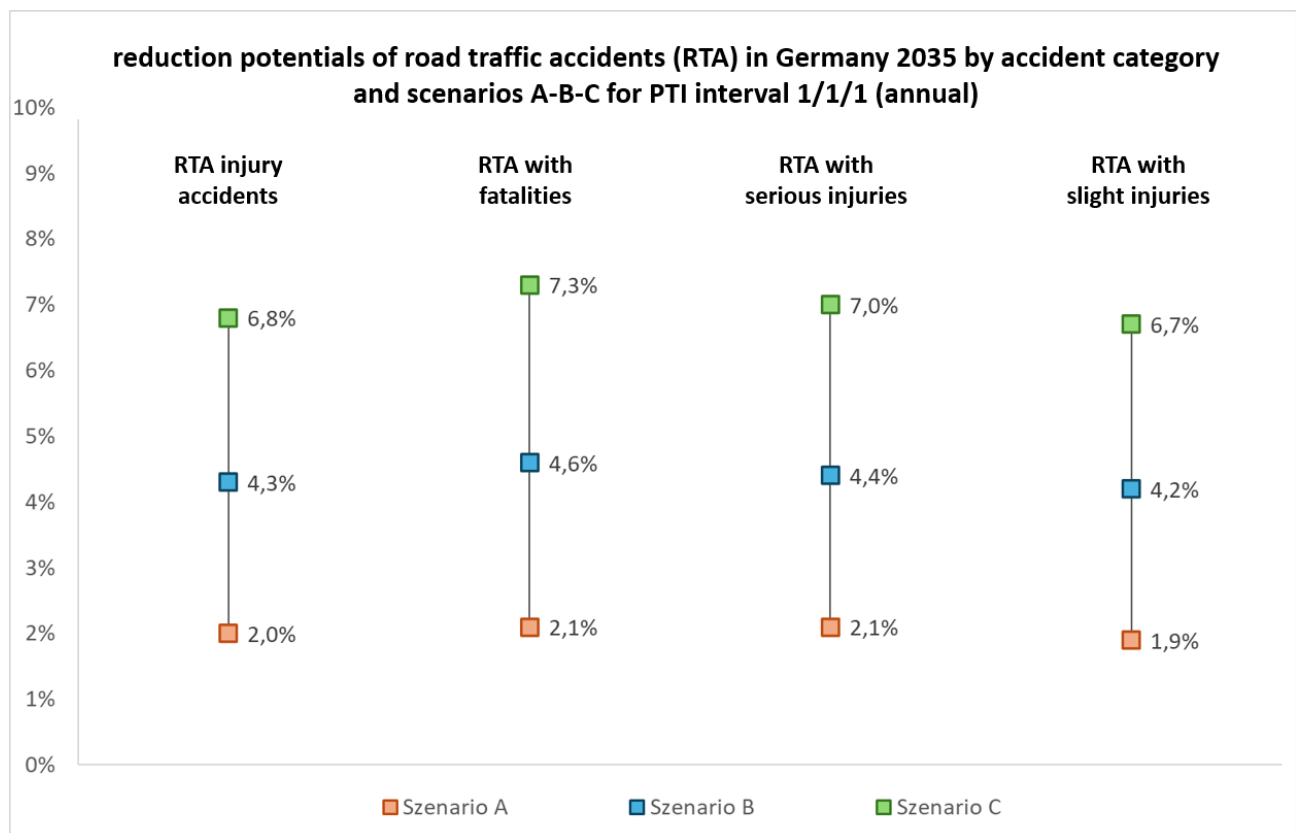


Figure 92: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/1/1 in 2035 under Scenarios A, B and C

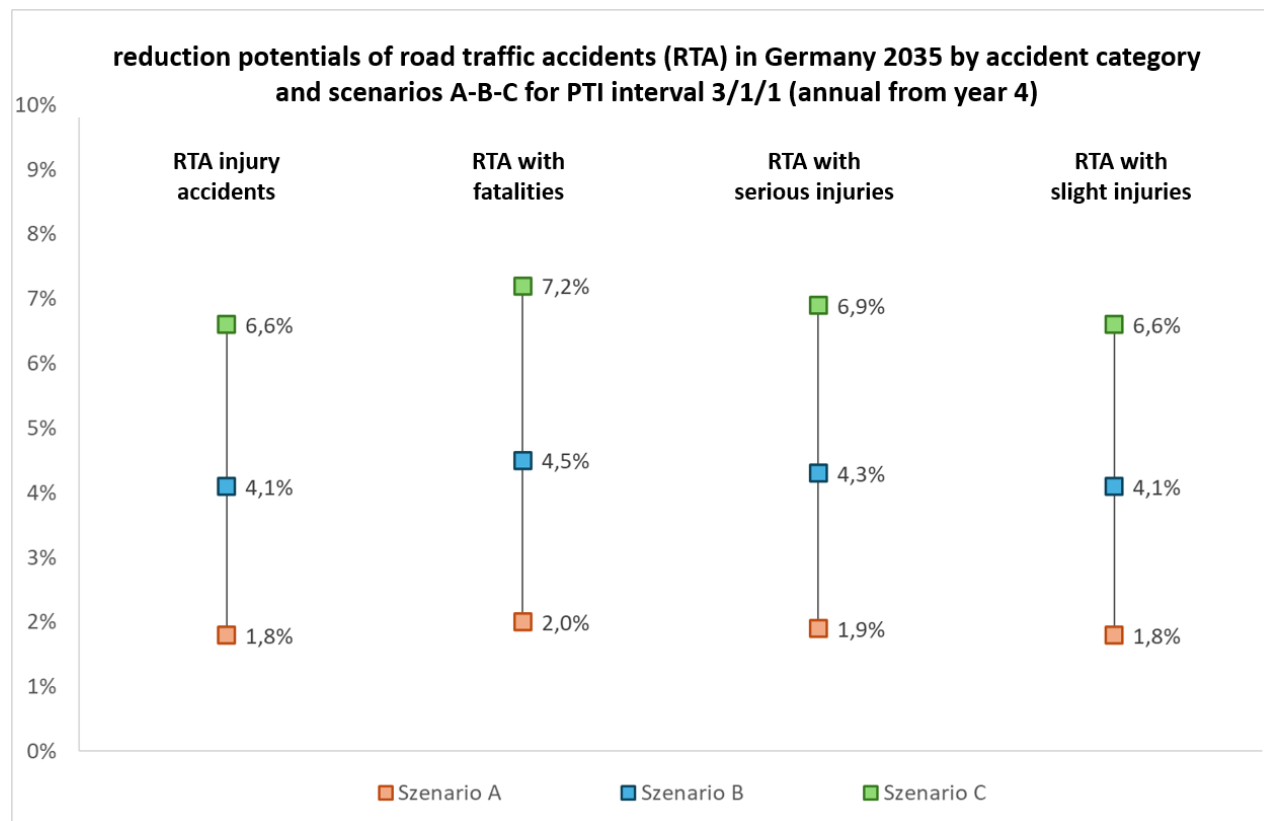


Figure 93: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/2/1 in 2035 under Scenarios A, B and C

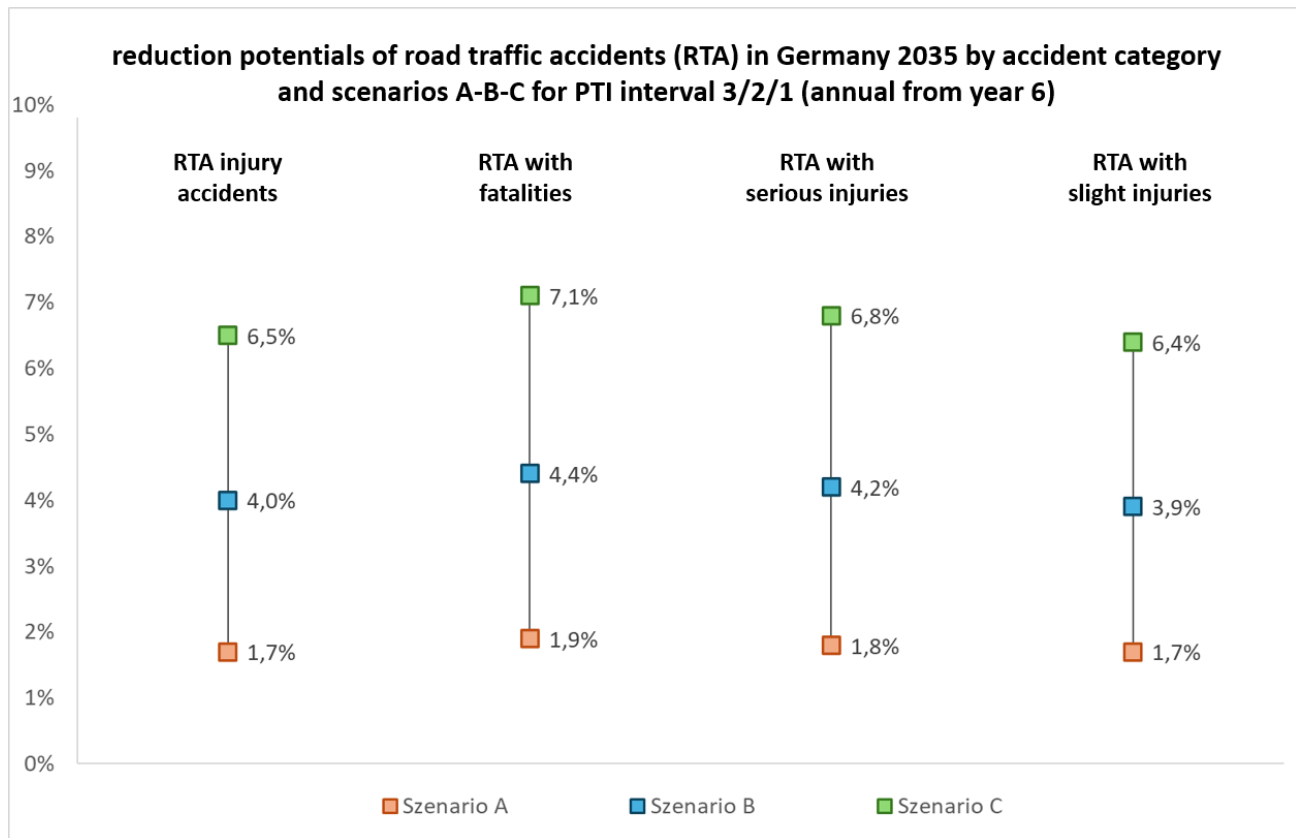


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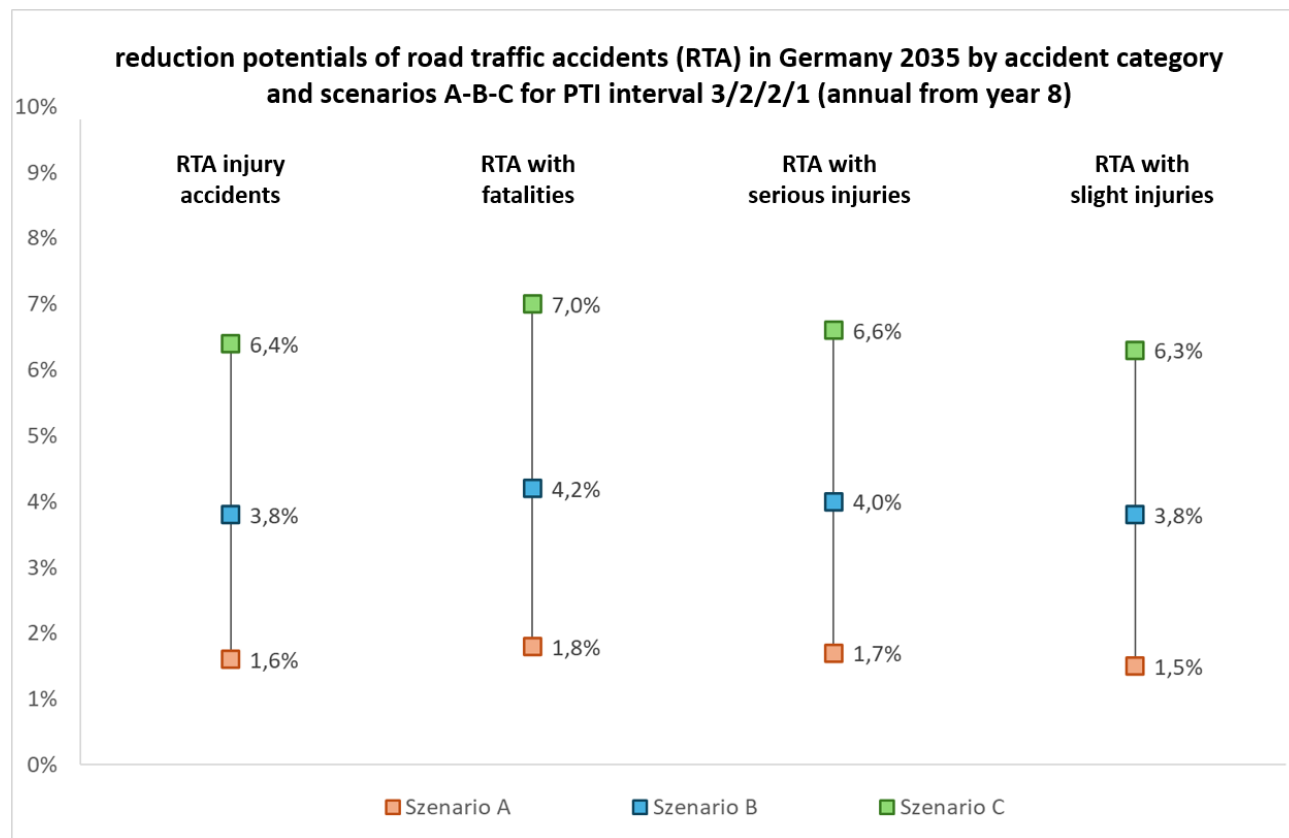


Figure 95: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/2/2/2/1 in 2035 under Scenarios A, B and C

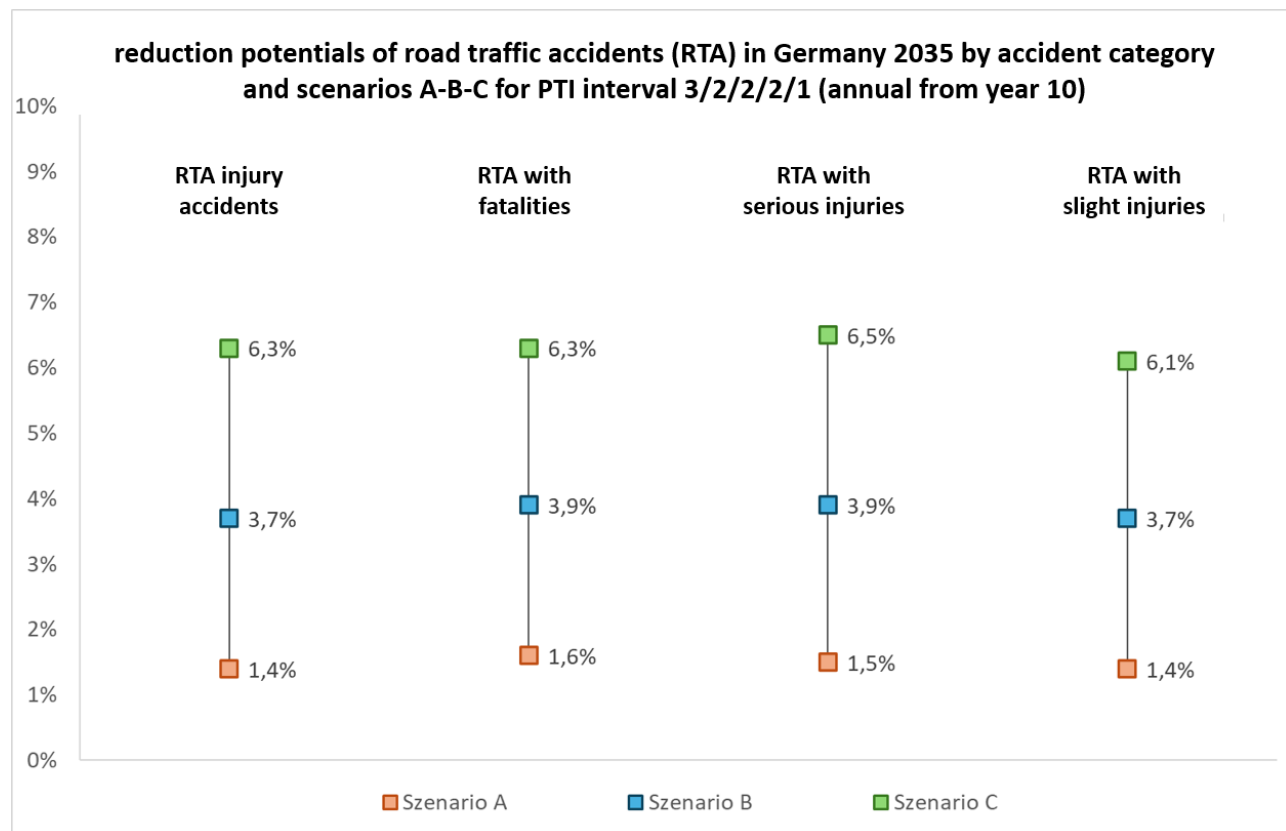


Figure 96: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/2/2/2/1 in 2035 under Scenarios A, B and C

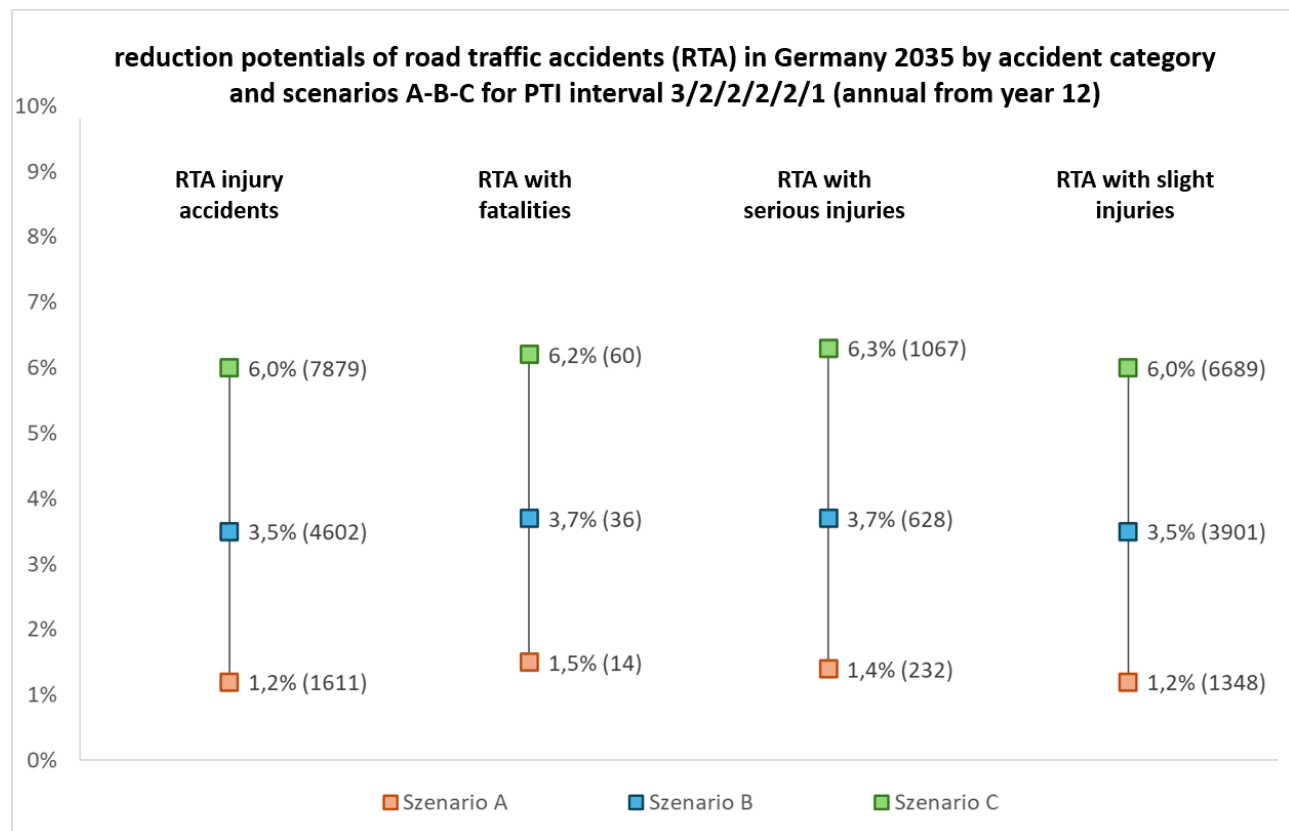


Figure 97: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/2/2/2/2/1 in 2035 under Scenarios A, B and C

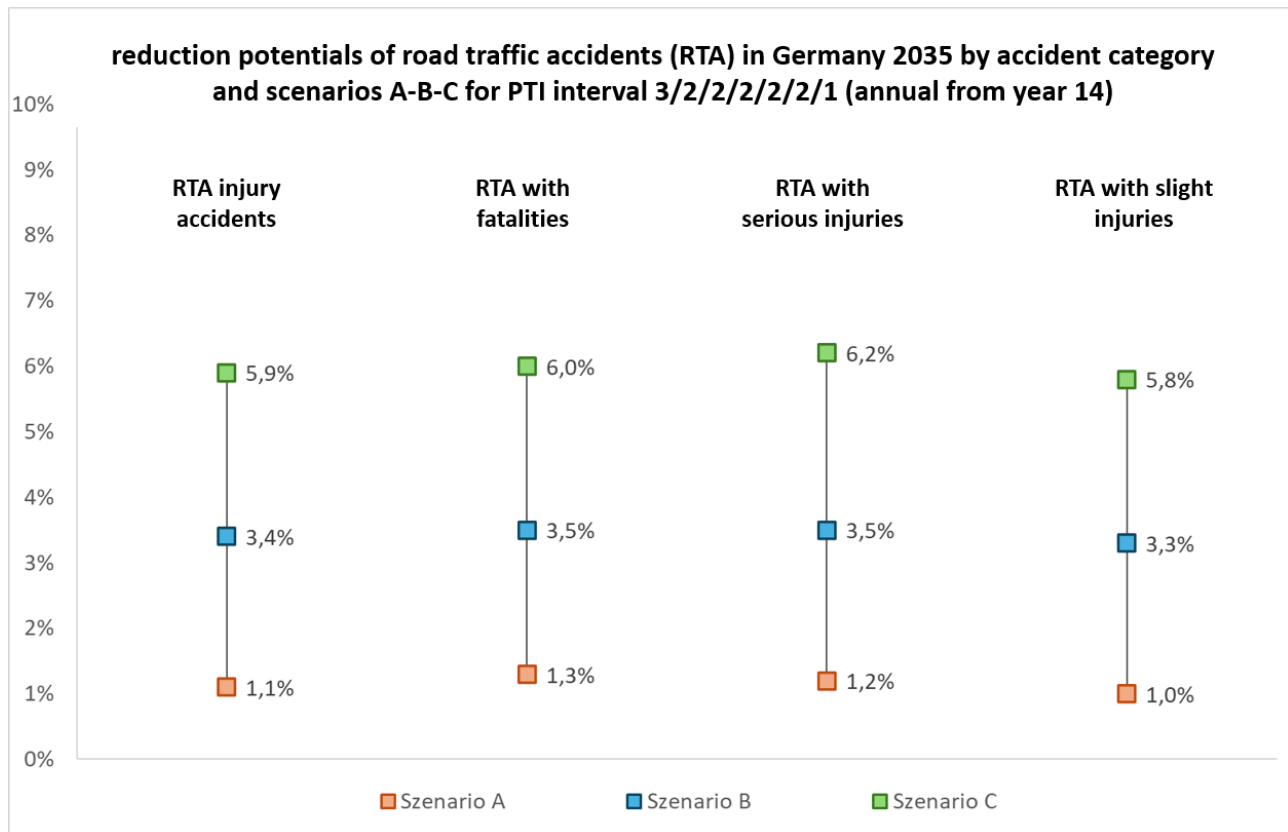
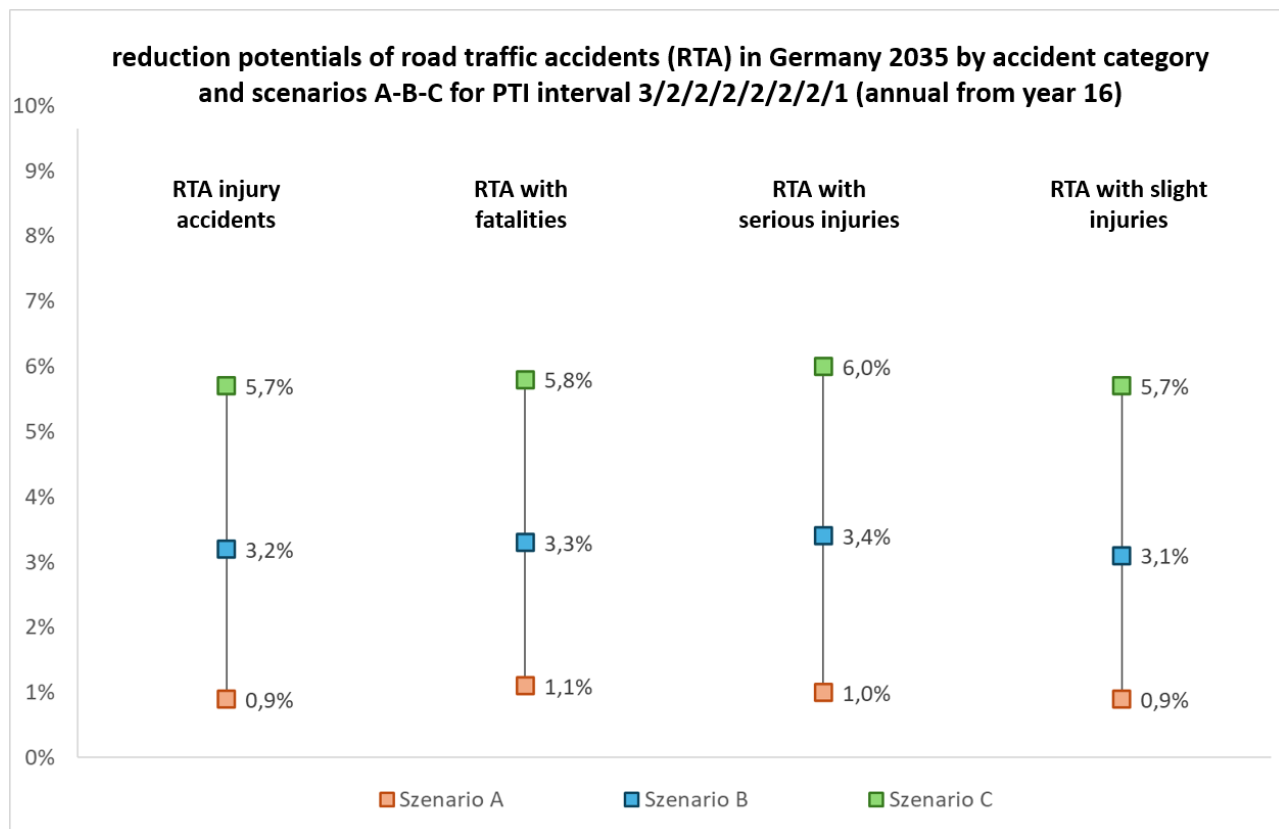


Figure 98: Potential estimate - overview of reduction potentials through HU/PTI inspection interval 3/2/2/2/2/2/1 in 2035 under Scenarios A, B and C



The results show that the reduction potential depends substantially on the assumed starting point of annual periodic technical inspections. The earlier in the vehicle life a transition to annual inspections takes place, the greater the modelled reduction potential. At the same time, the scenarios for fleet and mileage development affect the size of the potentials because they change the age-related distribution of passenger-car primary causers in 2035.

For passenger-car-caused accidents involving personal injury, the relative reduction potential lies between 0.9% and 7.3%, depending on the scenario and the assumed starting point of annual periodic technical inspections. These values relate to accident events. They are therefore not directly equivalent to the number of injured or killed persons.

The transfer to the level of persons requires an additional classification, because several persons can be injured or killed in one accident event. The absolute effects on the number of fatalities, seriously injured persons and slightly injured persons therefore depend on the occupancy structure, the structure of parties involved and the severity distribution of the accidents avoided. A direct proportional transfer of the calculated accident potentials to numbers of persons would therefore not be permissible without further assumptions. The reported values are accordingly to be understood as model-based reduction potentials at the level of accident events.

7.9 Conclusion on the potential estimate

The results show that the model developed enables a differentiated estimate of the reduction potential for passenger-car-caused accidents resulting from changed HU/PTI inspection intervals. The potential depends substantially on the vehicle age from which a transition to annual periodic technical inspections is assumed. The earlier within the considered vehicle life annual inspection begins, the greater the modelled reduction potential. At the same time, the scenarios for fleet and mileage development influence the level of the potentials because they change the age-related distribution of passenger-car primary causers in 2035.

For passenger-car-caused accidents involving personal injury, the relative reduction potential lies between 0.9% and 7.3%, depending on the scenario and the assumed starting point of annual periodic technical inspections. These values relate to accident events and not directly to the number of persons injured or killed. A direct transfer to fatalities, seriously injured persons or slightly injured persons is therefore possible only to a limited extent, since several persons may be affected in one accident and the concrete effect additionally depends on occupancy structure, the structure of parties involved and the severity distribution of the accidents avoided.

The results are to be understood as a model-based potential estimate and rest on several assumptions. These include, first, the assumption that the number of passenger-car primary causers within an age group is approximately proportional to the total mileage of that age group. This proportionality assumption is technically plausible, since without mileage there is no traffic exposure and therefore no mileage-related accident risk. It remains a simplification, however, because actual accident risk is also influenced by driver characteristics, usage patterns, road types, vehicle equipment and general developments in road safety.

Further uncertainties arise from the accident-data basis. The DEKRA accident data used allow a substantially more in-depth assessment of accident-relevant technical defects, but they should not be understood as a fully representative image of overall accident occurrence. The cases are based predominantly on accident-analytical expert reports concerning more serious or more deeply investigated accidents. Although comparisons by vehicle age, driver age and gender show a very plausible structure, selection and recording processes may nevertheless lead to distortions whose extent cannot be conclusively determined with the available data.

The statistical modelling is also associated with uncertainty. The age-dependent share of accident-relevant technical defects was estimated using logistic regression. This enables the observed relationship between vehicle age and defect probability to be represented systematically; at the same time, every extrapolation and smoothing remains dependent on model form, data scope and case numbers in the respective age ranges. The same applies

to the conversion of classified Destatis accident data back into individual vehicle-age classes using a Weibull distribution. This modelling is necessary in order to apply the age-dependent defect probabilities, but it is also a computational approximation.

The periodic reset model of defect probability is also central to the potential estimate. This model reflects the fact that, after a passed periodic technical inspection, vehicles must not have any identified major or dangerous defects, and that defect probability then rises again until the next PTI. The exponential trajectory assumed within a PTI period is technically plausible because it describes the occurrence of a defect as a waiting-time model and permits meaningful behaviour even under changed inspection intervals. Nevertheless, this trajectory is not directly empirically proven. Such proof would require event-independent technical inspections of vehicles at different times within an ongoing PTI period. Sensitivity analyses with alternative curve trajectories, such as linear interpolation, indicate, however, that the order of magnitude of the results remains largely stable across plausible model variants.

The scenarios for 2035 should likewise not be interpreted as secured forecasts. They describe different plausible developments of passenger-car fleet size and mileage and show how dependent the results are on these assumptions. The future development of older passenger cars is particularly uncertain, because changed HU/PTI inspection intervals can themselves have feedback effects on repair decisions, deregistrations and replacement purchases. Scenarios A, B and C do not fully capture this uncertainty, but they enable a structured sensitivity analysis.

A further central assumption concerns the transfer of reduced defect probability to accident occurrence. The model assumes that a reduction in the share of vehicles with major or dangerous defects has a proportional effect on the share of accidents in which accident-relevant technical defects are present. This assumption is understandable for a potential estimate, but it cannot fully represent the complex causality of individual accident events. The reported values should therefore not be understood as an exact prediction of preventable accidents, but as a model-supported estimate of a plausible reduction corridor.

Despite these limitations, the results provide substantial added insight. For the first time, the study connects several levels that have previously often been considered separately: the technical condition of vehicles in traffic, age-dependent defect development, the effect of periodic technical inspections, the age structure of the passenger-car fleet, mileage as an exposure variable and accident-relevant technical defects in accident occurrence. This makes it possible to quantify transparently at which vehicle ages additional periodic technical inspections would be particularly effective according to the model, and how strongly the results depend on assumptions regarding fleet size, mileage and modelling.

The special value of the analysis therefore lies not only in the specific percentage values, but above all in the methodology developed. It makes it possible to compare different

HU/PTI interval schemes systematically, age-dependently and scenario-based. The study thereby provides a robust basis for discussing the road-safety effects of changed inspection intervals on a more technically sound footing and for focusing future investigations on the empirical questions that remain open.

8 Summary

The present analysis confirms the central role of periodic technical inspection as an integral component of the road-safety strategy in Germany and Europe. At the same time, the framework conditions are undergoing structural change, shaped in particular by the continuing ageing of the vehicle fleet, technological innovation and efforts to harmonise European regulatory frameworks.

Accident analyses consistently show that human error is the dominant cause of accidents. By comparison, technical defects contribute only to a limited extent to accident occurrence in official statistics, but they become more important as vehicle age increases. National and international studies consistently document a marked increase in the frequency and severity of defects among older vehicles. At the same time, empirical field investigations show that the actual technical condition of vehicles in road traffic is often worse than is reflected by periodic-inspection data, because vehicles are specifically repaired before the PTI. A high share of major and dangerous defects is particularly evident among older vehicles.

Official accident statistics also capture technical defects only to a limited extent, because their recording is essentially based on externally visible findings. In-depth accident analyses, such as those available in the DEKRA accident database, by contrast show a higher significance of accident-relevant technical defects in serious accidents. A clear age-dependent relationship between vehicle age and accident-relevant technical defects can be demonstrated.

On the basis of these empirical findings, a model-based approach was developed that describes the temporal course of defect probability between periodic technical inspections. This so-called periodic reset model takes into account that vehicles are initially free of major or dangerous defects after passing the PTI and that defect probability rises again until the next inspection. This makes it possible to analyse different PTI inspection intervals in model terms and to quantify their influence on the share of vehicles with safety-relevant defects in traffic. The results show that shortened inspection intervals can lead to a substantial reduction in defect frequency.

The transfer of these effects to accident occurrence is carried out by means of further modelling assumptions. For passenger-car-caused accidents involving personal injury, the relative reduction potential ranges between 0.9% and 7.3%, depending on the scenarios for fleet and mileage development and on the selected starting point for an annual PTI interval. These values represent model-based projections, whose informative value is limited by assumptions regarding mileage, the age distribution of vehicles and the effect of technical defects on accident occurrence.

Additional uncertainties arise from the statistical modelling, for example logistic regression and distributional assumptions, from the empirical data basis regarding the course of defect development between periodic technical inspections, and from the formation of scenarios

for future developments up to 2035. The assumption that reduced defect probabilities have a proportional effect on accident occurrence is also a necessary simplification of complex accident causality.

Despite these limitations, the study provides a substantial gain in knowledge. For the first time, technical condition development, vehicle age, vehicle fleet, mileage and accident occurrence are brought together in an integrated modelling approach. This makes it possible to quantify transparently the age ranges in which additional periodic technical inspections can unfold the greatest safety-relevant potential.

The central added value of the work therefore lies less in individual numerical results than in the methodology developed. This methodology enables a differentiated, age-dependent and scenario-based assessment of alternative inspection intervals and creates a robust basis for the technical discussion of future adjustments to HU/PTI inspection intervals as well as for further empirical research.

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Bibliography

Q01 - Kritische Würdigung der (Zwischen-) Ergebnisse der vom ADAC in Auftrag gegebenen Studie zum Einfluss der HU-Prüffristen auf die Unfallhäufigkeit, FSD, 2012

Q02 - Pkw-Dichte bei älteren Fahrzeughalterinnen und -haltern steigt, KBA, 2023

Q03 - Überprüfung der Untersuchungsfristen, BMVBW, 2002

Q04 - ADAC Stellungnahme zur jährlichen HU, ADAC, 2025

Q05 - AUTOFORE - Study on the Future Options for Roadworthiness Enforcement in the European Union, CITA, 2007

Q06 - Status: Berliner Erklärung zur Fahrzeugsicherheit 2016, VDI, 2016

Q08 - Commission Staff Working Document Impact Assessment Report, European Commission, 2025

Q10 - Implementation of the roadworthiness package, European Parliament, 2020

Q12 - Injury-severity analysis of crashes involving defective vehicles and accounting for the underlying socioeconomic mediators, Adanu et al, 2024, USA

Q13 - Relationship between vehicle defects checked in roadworthiness inspections and those identified in collision analyses, CITA, 2024

Q14 - Examination of the results of the vehicles technical inspections in relation to the average age of vehicles in selected EU states, Hudec et al, 2021, SVK

Q15 - Roadworthiness Testing Contribution to Vehicle Safety and Environment, Díaz López et al, 2018, ESP

Q18 - Identifying the causes of road crashes in Europe, Thomas et al., 2013, SE

Q19 - Rejection Rate By PTI Frequency And Vehicle Age (M1, N1 & L) Spain, Magaz, G., 2025, ESP

Q21 - DAT Report 2023, DAT, 2023

Q22 - DAT Report 2024, DAT, 2024

Q23 - DAT Report 2025, DAT, 2025

Q26 - Verkehrssicherheitsreport 2015, DEKRA, 2015

Q27 - Verkehrssicherheitsreport 2025, DEKRA, 2025

Q29 - Pannenstatistik 2024, ADAC, 2024

Q30 - Pannenstatistik 2025, ADAC, 2025

Q31 - Stellungnahme EU Richtlinie 2014/45/EU, TÜV Verband e.V., 2025

Q33 - Evaluating Efficacy of PTI in Türkiye, IERC, 2024

Q34 - Impact Study – PTI Turkey, IERC, 2016

Q35 - Commission Staff Working Document Impact Assessment Report, European Commission, 2025

Q36 - VUFO Studie: Einfluss der HU-Frist auf das Verkehrsunfallgeschehen, ADAC, 2012

Q37 - FZ Sicherheit 1990, HUK Verband, 1990

Q38 - BASt M30, BASt, 1994

Q39 - Vorschlag für eine Verordnung des Europäischen Parlaments und des Rates über die regelmäßige technische Überwachung von Kraftfahrzeugen und Kraftfahrzeuganhängern und zur Aufhebung der Richtlinie 2009/40/EG, Hier: Kosten-Nutzen-Analyse für Deutschland, BASt, 2012

Q40 - Jahresbericht über die Altfahrzeug-Verwertungsquoten in Deutschland im Jahr 2021, Bundesministerium Umwelt, 2021

Q41 - Validierung von Prüfvorgaben – Ergebnisse 2008-2010, FSD

Q42 - Untersuchung von Mängelquoten bei Selbstfahrvermietfahrzeugen, FSD, 2022

Q43 - Mängelquote nach Fahrzeugalter, FSD, 2024, Verfasser: Hannah Ende

Q44 - Circularity requirements for vehicle design and management of end-of-life vehicles, EUP, 2025

Q45 - TÜV Report 2026, TÜV, 2025

Q46 - ACEA, Januar 2025, Vehicles on European Roads 2025, Seite 11

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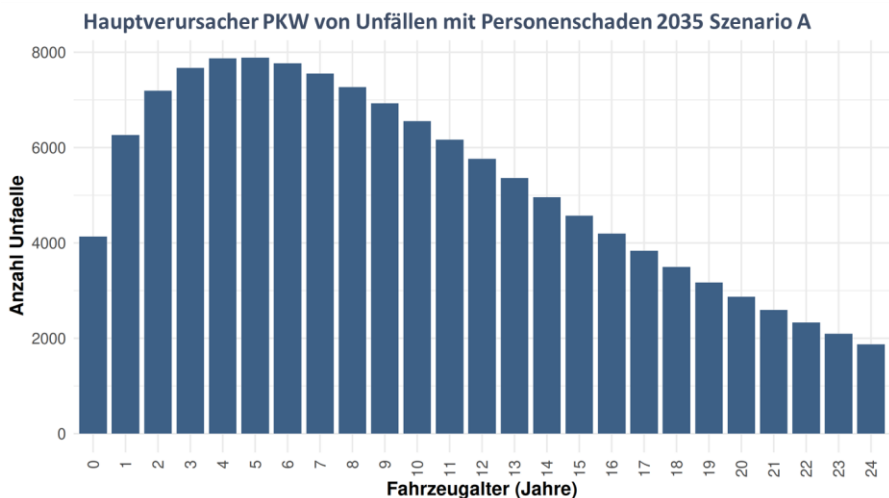
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Anhang 1: - PTI Ländervergleich

Country		M1	N1	Remarks
	EU	4-2-2	4-2-2	
Austria	AT	3-2-1	1-1-1	M1: annually from 5 years
Belgium	BE	4-1-1	1-1-1	M1: annually after first inspection (with a bonus system for longer intervals)
Bulgaria	BG	3-2-1	3-2-1	M1: annually from 5 years
Cyprus*	CY	4-2-2	1-1-1	M1: first inspection 4 years after first registration, then every 2 years
Czechia*	CZ	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
Germany*	DE	3-2-2	2-2-2	M1: first inspection 3 years after first registration, then every 2 years
Denmark*	DK	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
Estonia	EE	4-2-2	2-1-1	M1: annually from 10 years
Greece*	GR	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
Spain	ES	4-2-2	2-2-2	M1: annually from 10 years; N1: annually from 6 years, every six months from 10 years
Finland	FI	4-2-2	1-1-1	M1: annually from 10 years
France*	FR	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
Croatia	HR	2-1-1	2-1-1	M1: annually after first inspection
Hungary*	HU	4-2-2	2-2-2	M1: first inspection 4 years after first registration, then every 2 years
Ireland	IE	4-2-2	1-1-1	M1: annually from 10 years
Italy*	IT	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
Lithuania*	LT	3-2-2	2-1-1	M1: first inspection 3 years after first registration, then every 2 years
Luxembourg	LU	4-2-1	1-1-1	M1: annually from 6 years
Latvia	LV	3-2-2	2-2-2	M1: annually from 10 years
Malta*	MT	4-2-2	1-1-1	M1: first inspection 4 years after first registration, then every 2 years
Netherlands	NL	4-2-2	2-2-2	M1: annually from 8 years for petrol/electric vehicles; for diesel/gas vehicles, 3 years after first registration, then annually
Poland	PL	3-2-2	3-2-2	M1: annually from 10 years
Portugal	PT	4-2-2	2-1-1	M1: annually from 8 years
Romania	RO	3-2-2	1-1-1	M1: annually from 12 years
Sweden	SE	3-2-14m	3-2-14m	M1: 3-2-14 months
Slovenia	SI	4-2-2	1-1-1	M1: annually from 8 years
Slovakia*	SK	4-2-2	4-2-2	M1: first inspection 4 years after first registration, then every 2 years
*Member States without annual PTI for older passenger cars				

Anhang 2: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Personenschaden im Jahr 2035 nach Szenario A



Anhang 3: - PKW Hauptverursacher von Unfällen mit Personenschaden - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario A

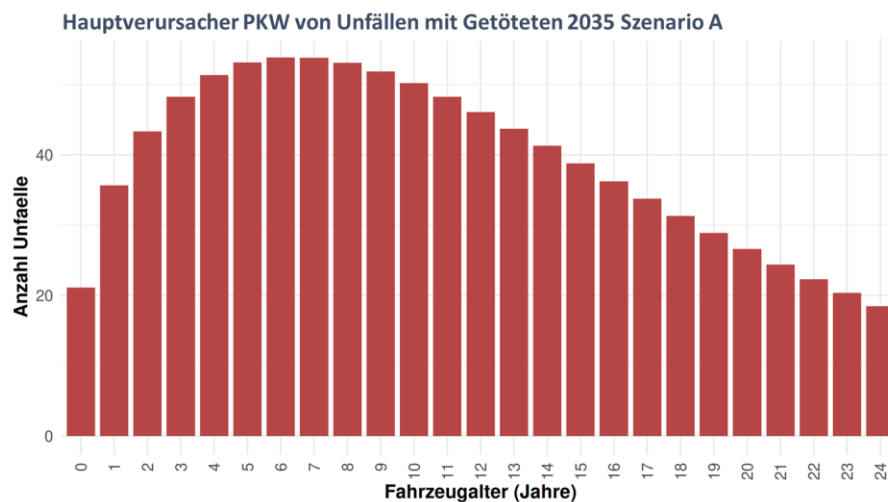
Unfälle mit Personenschaden von Hauptverursachern PKW über das Fahrzeugalter im Jahr 2035 Szenario A

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	4.135	2,2%	89	4.046
1	6.265	2,4%	149	6.116
2	7.192	2,6%	189	7.003
3	7.669	2,9%	222	7.447
4	7.873	3,2%	252	7.621
5	7.889	3,5%	278	7.610
6	7.770	3,9%	302	7.468
7	7.553	4,3%	324	7.229
8	7.266	4,7%	343	6.922
9	6.928	5,2%	361	6.567
10	6.556	5,7%	376	6.181
11	6.164	6,3%	389	5.776
12	5.762	6,9%	400	5.363
13	5.358	7,6%	408	4.950
14	4.959	8,4%	415	4.544
15	4.569	9,2%	419	4.150
16	4.193	10,1%	422	3.771
17	3.834	11,0%	423	3.412
18	3.493	12,1%	421	3.072
19	3.172	13,2%	418	2.754
20	2.871	14,4%	413	2.458
21	2.592	15,7%	406	2.185
22	2.332	17,1%	398	1.934
23	2.093	18,6%	389	1.705
24	1.874	20,1%	378	1.497
Summen	130.365		8.585	121.780

Anhang 4: - Ergebnisse Szenario A Unfälle mit Personenschaden

Reduktionspotential von PKW-verseuchten Unfällen mit Personenschaden im Jahr 2035 Szenario A durch jährliche Hauptuntersuchungen												
Alter	VKU PS verseucht von PKW gesamt	VKU PS verseucht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU PS verseucht von PKW mit unfallrelevanten Mängeln	HU Untersuchungsfrist 1/11/... (jährlich)	HU Untersuchungsfrist 3/11/... (ab 4 jährlich)	HU Untersuchungsfrist 3/21/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/21/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/22/11/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/22/11/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/22/21/11/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/22/22/21/11/... (ab 16 jährlich)
0	4.135	89	0,0%	0	x		0			0	0	0
1	6.265	149	54,2%	81	x	81	0	0	0	0	0	0
2	7.192	189	64,4%	122	x	122	0	0	0	0	0	0
3	7.669	222	0,0%	0	x	0	x	0	x	0	x	0
4	7.873	252	58,9%	148	x	148	0	0	0	0	0	0
5	7.889	278	0,0%	0	x	0	x	0	x	0	x	0
6	7.770	302	58,8%	178	x	178	x	178	0	0	0	0
7	7.553	324	0,0%	0	x	0	x	0	x	0	x	0
8	7.266	343	58,5%	201	x	201	x	201	0	0	0	0
9	6.928	361	0,0%	0	x	0	x	0	x	0	x	0
10	6.556	376	58,1%	218	x	218	x	218	x	218	0	0
11	6.164	389	0,0%	0	x	0	x	0	x	0	x	0
12	5.762	400	57,6%	230	x	230	x	230	x	230	x	0
13	5.358	408	0,0%	0	x	0	x	0	x	0	x	0
14	4.959	415	57,2%	237	x	237	x	237	x	237	x	237
15	4.569	419	0,0%	0	x	0	x	0	x	0	x	0
16	4.193	422	56,7%	239	x	239	x	239	x	239	x	239
17	3.834	423	0,0%	0	x	0	x	0	x	0	x	0
18	3.493	421	56,4%	238	x	238	x	238	x	238	x	238
19	3.172	418	0,0%	0	x	0	x	0	x	0	x	0
20	2.871	413	56,1%	232	x	232	x	232	x	232	x	232
21	2.592	406	0,0%	0	x	0	x	0	x	0	x	0
22	2.332	398	55,9%	223	x	223	x	223	x	223	x	223
23	2.093	389	0,0%	0	x	0	x	0	x	0	x	0
24	1.874	378	56,1%	212	x	212	x	212	x	212	x	212
	130.365	8.585		2.558	2558	2356	2208	2030	1829	1611	1380	1143
Potential bezogen auf alle Unfälle mit Personenschaden					1,96%	1,81%	1,69%	1,56%	1,40%	1,24%	1,06%	0,88%

Anhang 5: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Getöteten im Jahr 2035 nach Szenario A



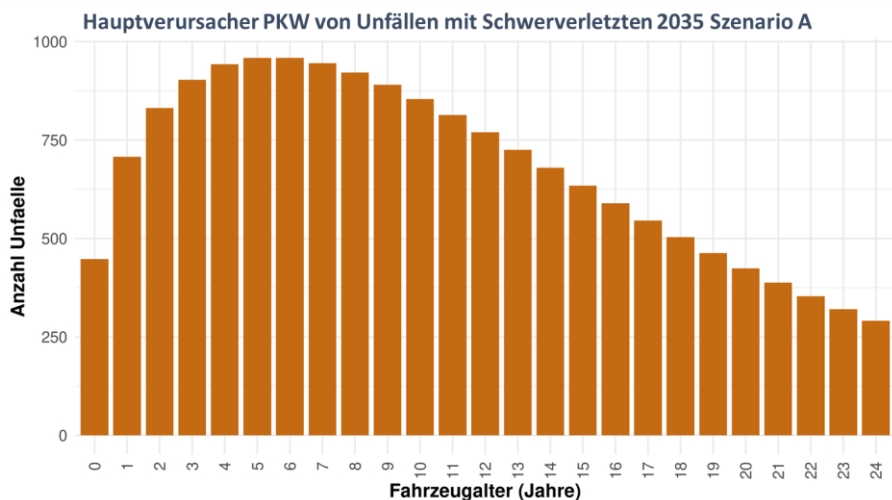
Anhang 6: - PKW Hauptverursacher von Unfällen mit Getöteten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario A

Unfälle mit Getöteten von Hauptverursachern PKW über das Fahrzeugalter im Jahr 2035 Szenario A				
Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	21	2,2%	0	21
1	36	2,4%	1	35
2	43	2,6%	1	42
3	48	2,9%	1	47
4	51	3,2%	2	50
5	53	3,5%	2	51
6	54	3,9%	2	52
7	54	4,3%	2	51
8	53	4,7%	3	51
9	52	5,2%	3	49
10	50	5,7%	3	47
11	48	6,3%	3	45
12	46	6,9%	3	43
13	44	7,6%	3	40
14	41	8,4%	3	38
15	39	9,2%	4	35
16	36	10,1%	4	33
17	34	11,0%	4	30
18	31	12,1%	4	28
19	29	13,2%	4	25
20	27	14,4%	4	23
21	24	15,7%	4	21
22	22	17,1%	4	19
23	20	18,6%	4	17
24	18	20,1%	4	15
Summen	976		70	906

Anhang 7: - Ergebnisse Szenario A Unfälle mit Getöteten

Reduktionspotential von PKWverursachten Unfällen mit Getöteten im Jahr 2035 Szenario A durch jährliche Hauptuntersuchungen												
Alter	VKU GE verursacht von PKW gesamt	VKU GE verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU GE verursacht von PKW mit unfallrelevanten Mängeln	HU Untersuchungsfrist 1/1/11/... (jährlich)	HU Untersuchungsfrist 3/1/11/... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/11/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/21/1/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/22/11/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/22/21/1/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/22/22/11/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/22/22/21/1/... (ab 16 jährlich)
0	21	0	0,0%	0	x	0	0	0	0	0	0	0
1	36	1	54,2%	0	x	0	0	0	0	0	0	0
2	43	1	64,4%	1	x	1	0	0	0	0	0	0
3	48	1	0,0%	0	x	0	0	x	0	x	0	x
4	51	2	58,9%	1	x	1	1	0	0	0	0	0
5	53	2	0,0%	0	x	0	0	x	0	x	0	x
6	54	2	58,8%	1	x	1	1	1	0	0	0	0
7	54	2	0,0%	0	x	0	0	x	0	x	0	x
8	53	3	58,5%	1	x	1	1	1	1	0	0	0
9	52	3	0,0%	0	x	0	0	x	0	x	0	x
10	50	3	58,1%	2	x	2	2	2	2	0	0	0
11	48	3	0,0%	0	x	0	0	x	0	x	0	x
12	46	3	57,6%	2	x	2	2	2	2	2	0	0
13	44	3	0,0%	0	x	0	0	x	0	x	0	x
14	41	3	57,2%	2	x	2	2	2	2	2	2	0
15	39	4	0,0%	0	x	0	0	x	0	x	0	0
16	36	4	56,7%	4	x	2	2	2	2	2	2	2
17	34	4	0,0%	0	x	0	0	x	0	x	0	0
18	31	4	56,4%	2	x	2	2	2	2	2	2	2
19	29	4	0,0%	0	x	0	0	x	0	x	0	0
20	27	4	56,1%	2	x	2	2	2	2	2	2	2
21	24	4	0,0%	0	x	0	0	x	0	x	0	0
22	22	4	55,9%	2	x	2	2	2	2	2	2	2
23	20	4	0,0%	0	x	0	0	x	0	x	0	0
24	18	4	56,1%	2	x	2	2	2	2	2	2	2
	976	70		21	21	20	19	18	16	14	13	11
Potential bezogen auf alle Unfälle mit Getöteten					2,14%	2,02%	1,92%	1,79%	1,64%	1,47%	1,28%	1,08%

Anhang 8: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Schwerverletzten im Jahr 2035 nach Szenario A



Anhang 9: - PKW Hauptverursacher von Unfällen mit Schwerverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario A

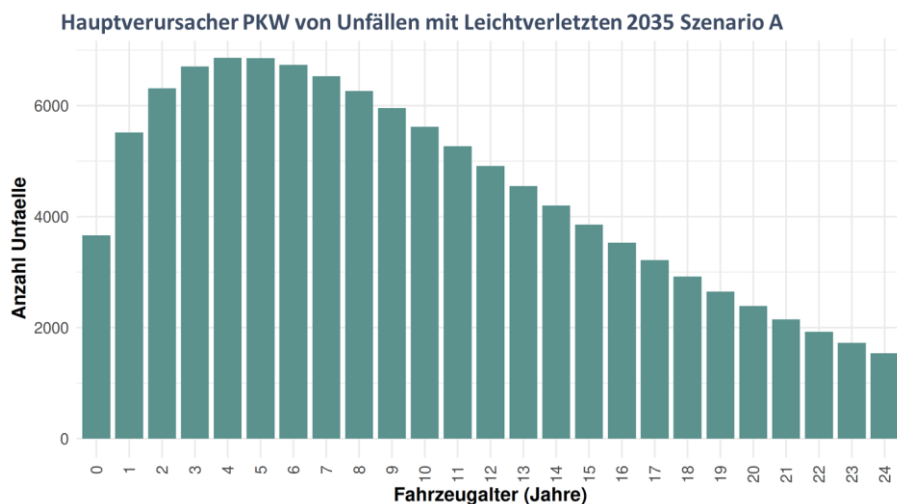
**Unfälle mit Schwerverletzten von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario A**

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	448	2,2%	10	438
1	707	2,4%	17	690
2	831	2,6%	22	809
3	903	2,9%	26	877
4	942	3,2%	30	912
5	959	3,5%	34	925
6	958	3,9%	37	921
7	945	4,3%	41	904
8	921	4,7%	44	878
9	890	5,2%	46	844
10	854	5,7%	49	805
11	813	6,3%	51	762
12	770	6,9%	53	717
13	725	7,6%	55	670
14	680	8,4%	57	623
15	634	9,2%	58	576
16	589	10,1%	59	530
17	546	11,0%	60	486
18	503	12,1%	61	443
19	463	13,2%	61	402
20	424	14,4%	61	363
21	388	15,7%	61	327
22	353	17,1%	60	293
23	321	18,6%	60	261
24	291	20,1%	59	232
Summen	16.860		1.172	15.689

Anhang 10: - Ergebnisse Szenario A Unfälle mit Schwerverletzten

Reduktionspotential von PKW verursachten Unfällen mit Schwerverletzten im Jahr 2035 Szenario A durch jährliche Hauptuntersuchungen													
Alter	VKU SV verursacht von PKW gesamt	VKU SV verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU SV verursacht von PKW mit unfallrelevanten Mängeln	HU Untersuchungsfrist 1/1/1... (jährlich)	HU Untersuchungsfrist 3/1/1/... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/2/1/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/1/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/2/1/... (ab 16 jährlich)	HU
0	448	10	0,0%	0	x	0	0	0	0	0	0	0	0
1	707	17	54,2%	9	x	9	0	0	0	0	0	0	0
2	831	22	64,4%	14	x	14	0	0	0	0	0	0	0
3	903	26	0,0%	0	x	0	0	x	0	x	0	x	0
4	942	30	58,9%	18	x	18	0	0	0	0	0	0	0
5	959	34	0,0%	0	x	0	0	x	0	x	0	x	0
6	958	37	58,8%	22	x	22	x	22	0	0	0	0	0
7	945	41	0,0%	0	x	0	0	x	0	x	0	x	0
8	921	44	58,5%	25	x	25	x	25	x	25	0	0	0
9	890	46	0,0%	0	x	0	0	x	0	x	0	x	0
10	854	49	58,1%	28	x	28	x	28	x	28	0	0	0
11	813	51	0,0%	0	x	0	0	x	0	x	0	x	0
12	770	53	57,6%	31	x	31	x	31	x	31	0	0	0
13	725	55	0,0%	0	x	0	0	x	0	x	0	x	0
14	680	57	57,2%	33	x	33	x	33	x	33	x	33	0
15	634	58	0,0%	0	x	0	0	x	0	x	0	x	0
16	589	59	56,7%	34	x	34	x	34	x	34	x	34	34
17	546	60	0,0%	0	x	0	0	x	0	x	0	x	0
18	503	61	56,4%	34	x	34	x	34	x	34	x	34	34
19	463	61	0,0%	0	x	0	0	x	0	x	0	x	0
20	424	61	56,1%	34	x	34	x	34	x	34	x	34	34
21	388	61	0,0%	0	x	0	0	x	0	x	0	x	0
22	353	60	55,9%	34	x	34	x	34	x	34	x	34	34
23	321	60	0,0%	0	x	0	0	x	0	x	0	x	0
24	291	59	56,1%	33	x	33	x	33	x	33	x	33	33
	16.860	1.172		349	349	326	308	286	260	232	201	169	
Potential bezogen auf alle Unfälle mit Schwerverletzten				2,07%	1,93%	1,83%	1,70%	1,54%	1,38%	1,19%	1,00%		

Anhang 11: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Leichtverletzten im Jahr 2035 nach Szenario A



Anhang 12: - PKW Hauptverursacher von Unfällen mit Leichtverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario A

Unfälle mit Leichtverletzten von Hauptverursachern PKW über das Fahrzeugalter im Jahr 2035 Szenario A

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	3.663	2,2%	79	3.584
1	5.517	2,4%	131	5.386
2	6.310	2,6%	166	6.145
3	6.707	2,9%	194	6.513
4	6.864	3,2%	220	6.645
5	6.859	3,5%	242	6.616
6	6.736	3,9%	262	6.474
7	6.529	4,3%	280	6.249
8	6.263	4,7%	296	5.967
9	5.955	5,2%	310	5.645
10	5.619	5,7%	322	5.297
11	5.268	6,3%	332	4.936
12	4.910	6,9%	340	4.569
13	4.552	7,6%	347	4.205
14	4.201	8,4%	351	3.849
15	3.859	9,2%	354	3.505
16	3.531	10,1%	355	3.176
17	3.219	11,0%	355	2.864
18	2.924	12,1%	353	2.571
19	2.647	13,2%	349	2.298
20	2.389	14,4%	344	2.045
21	2.149	15,7%	337	1.812
22	1.928	17,1%	329	1.599
23	1.725	18,6%	320	1.405
24	1.540	20,1%	310	1.229
Summen	111.863		7.280	104.584

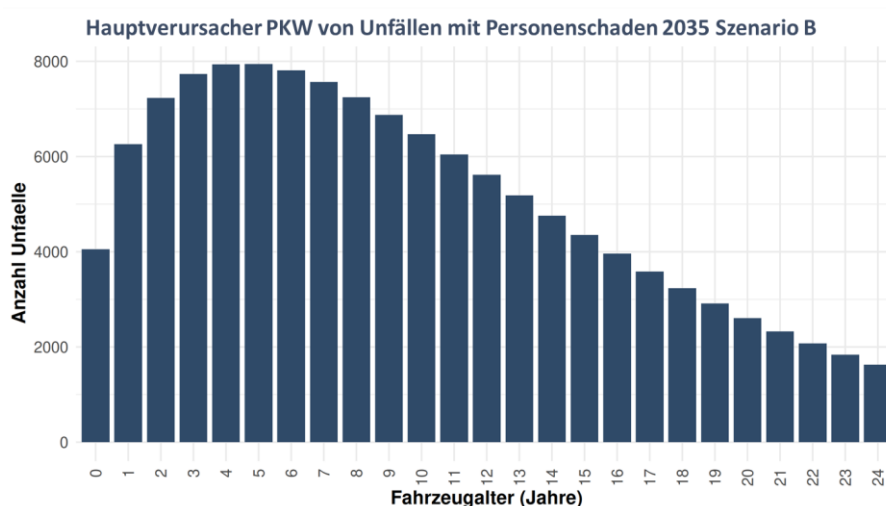
Anhang 13: - Ergebnisse Szenario A Unfälle mit Leichtverletzten

Reduktionspotential von PKW verursachten Unfällen mit Leichtverletzten im Jahr 2035 Szenario A durch jährliche Hauptuntersuchungen													
Alter	VKU LV verursacht von PKW gesamt	VKU LV verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU LV verursacht von PKW mit unfallrelevanten Mängeln	HU Untersuchungsfrist 1/1/1... (jährlich)	HU Untersuchungsfrist 31/1/1... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/1/1... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/1/1... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/1... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1/1... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/1/1... (ab 16 jährlich)	HU
0	3.663	79	0,0%	0	x	0	0	0	0	0	0	0	0
1	5.517	131	54,2%	71	x	0	0	0	0	0	0	0	0
2	6.310	166	64,4%	107	x	0	0	0	0	0	0	0	0
3	6.707	194	0,0%	0	x	0	0	0	0	0	0	0	0
4	6.864	220	58,9%	129	x	129	0	0	0	0	0	0	0
5	6.859	242	0,0%	0	x	0	0	0	0	0	0	0	0
6	6.736	262	58,8%	154	x	154	0	0	0	0	0	0	0
7	6.529	280	0,0%	0	x	0	0	0	0	0	0	0	0
8	6.263	296	58,5%	173	x	173	0	0	0	0	0	0	0
9	5.955	310	0,0%	0	x	0	0	0	0	0	0	0	0
10	5.619	322	58,1%	187	x	187	0	0	0	0	0	0	0
11	5.268	332	0,0%	0	x	0	0	0	0	0	0	0	0
12	4.910	340	57,6%	196	x	196	0	0	0	0	0	0	0
13	4.552	347	0,0%	0	x	0	0	0	0	0	0	0	0
14	4.201	351	57,2%	201	x	201	0	0	0	0	0	0	0
15	3.859	354	0,0%	0	x	0	0	0	0	0	0	0	0
16	3.531	355	56,7%	201	x	201	0	0	0	0	0	0	0
17	3.219	355	0,0%	0	x	0	0	0	0	0	0	0	0
18	2.924	353	56,4%	199	x	199	0	0	0	0	0	0	0
19	2.647	349	0,0%	0	x	0	0	0	0	0	0	0	0
20	2.389	344	56,1%	193	x	193	0	0	0	0	0	0	0
21	2.149	337	0,0%	0	x	0	0	0	0	0	0	0	0
22	1.928	329	55,9%	184	x	184	0	0	0	0	0	0	0
23	1.725	320	0,0%	0	x	0	0	0	0	0	0	0	0
24	1.540	310	56,1%	174	x	174	0	0	0	0	0	0	0
	111.863	7.280		2.170	1992	1863	1709	1535	1348	1152	951	0,85%	
Potential bezogen auf alle Unfälle mit Leichtverletzten				1,94%	1,78%	1,67%	1,53%	1,37%	1,21%	1,03%	0,85%		

Anhang 14: - Übersicht Reduktionspotentiale Verkehrsunfälle nach Szenario A

Reduktionspotential von PKW verursachten Unfällen 2035 Szenario A durch jährliche Hauptuntersuchungen										
Unfallkategorie	Anzahl Unfälle gesamt	HU Untersuchungsfrist 1/1/1/... (jährlich)	HU Untersuchungsfrist 3/1/1/... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/2/1/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/1/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/2/1/... (ab 16 jährlich)	
Unfälle mit Personenschaden	130.365	-2558 -2,0%	-2356 -1,8%	-2208 -1,7%	-2030 -1,6%	-1829 -1,4%	-1611 -1,2%	-1380 -1,1%	-1143 -0,9%	
Unfälle mit Getöteten	976	-21 -2,1%	-20 -2,0%	-19 -1,9%	-18 -1,8%	-16 -1,6%	-14 -1,5%	-13 -1,3%	-11 -1,1%	
Unfälle mit Schwerverletzten	16.860	-349 -2,1%	-326 -1,9%	-308 -1,8%	-286 -1,7%	-260 -1,5%	-232 -1,4%	-201 -1,2%	-169 -1,0%	
Unfälle mit Leichtverletzten	111.863	-2170 -1,9%	-1992 -1,8%	-1863 -1,7%	-1709 -1,5%	-1535 -1,4%	-1348 -1,2%	-1152 -1,0%	-951 -0,9%	

Anhang 15: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Personenschaden im Jahr 2035
nach Szenario B



Anhang 16: - PKW Hauptverursacher von Unfällen mit Personenschaden - Aufteilung mit/ohne unfallrelevante Mängel
nach Szenario B

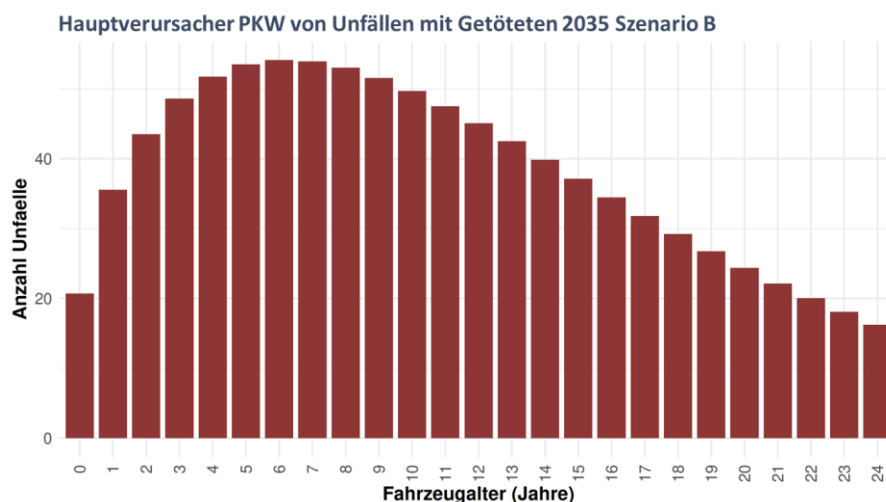
Unfälle mit Personenschaden von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario B

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	4.055	2,2%	87	3.967
1	6.259	2,4%	149	6.110
2	7.232	2,6%	190	7.042
3	7.732	2,9%	224	7.508
4	7.940	3,2%	254	7.686
5	7.946	3,5%	280	7.666
6	7.808	3,9%	304	7.504
7	7.565	4,3%	325	7.240
8	7.246	4,7%	343	6.904
9	6.875	5,2%	358	6.517
10	6.470	5,7%	371	6.100
11	6.046	6,3%	381	5.665
12	5.614	6,9%	389	5.224
13	5.183	7,6%	395	4.788
14	4.759	8,4%	398	4.361
15	4.350	9,2%	399	3.951
16	3.958	10,1%	398	3.560
17	3.586	11,0%	395	3.191
18	3.237	12,1%	390	2.847
19	2.911	13,2%	384	2.527
20	2.608	14,4%	375	2.233
21	2.329	15,7%	365	1.964
22	2.074	17,1%	354	1.720
23	1.841	18,6%	342	1.499
24	1.629	20,1%	328	1.301
Summen	127.253		8.180	119.074

Anhang 17: - Ergebnisse Szenario B Unfälle mit Personenschaden

Reduktionspotential von PKW verursachten Unfällen mit Personenschaden im Jahr 2035 Szenario B durch jährliche Hauptuntersuchungen																					
Alter	VKU PS verursacht von PKW gesamt	Veränderung VKU PS durch Auflagerheb- setzungen	VKU PS verursacht von PKW gesamt ohne Außerbetriebsetzungen	VKU PS verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU PS verursacht von PKW mit unfallrelevanten Mängeln	HU 11/11... (jährlich)		HU 31/11... (ab 4 jährlich)		HU 32/11... (ab 6 jährlich)		HU 32/20/21... (ab 10 jährlich)		HU 32/20/21... (ab 12 jährlich)		HU 32/20/21... (ab 14 jährlich)		HU 32/20/21... (ab 16 jährlich)		
							x														
0	4.135	80	4.055	87	0,0%	0	x	80		80		80		80		80		80		80	
1	6.265	6	6.259	149	54,2%	81	x	87		6		6		6		6		6		6	
2	7.192	-40	7.232	190	64,4%	122	x	82		-40		-40		-40		-40		-40		-40	
3	7.669	-63	7.732	224	0,0%	0	x	-63	x	-63	x	-63	x	-63	x	-63	x	-63	x	-63	x
4	7.873	-67	7.940	254	58,9%	150	x	82	x	82		-67		-67		-67		-67		-67	
5	7.889	-58	7.946	280	0,0%	0	x	-58	x	-58	x	-58	x	-58	x	-58	x	-58	x	-58	x
6	7.770	-38	7.808	304	58,8%	179	x	141	x	141		-38		-38		-38		-38		-38	
7	7.553	-11	7.565	325	0,0%	0	x	-11	x	-11	x	-11	x	-11	x	-11	x	-11	x	-11	x
8	7.266	20	7.246	343	58,5%	200	x	220	x	220	x	220	x	220	x	220	x	220	x	220	x
9	6.928	53	6.875	358	0,0%	0	x	53	x	53	x	53	x	53	x	53	x	53	x	53	x
10	6.556	86	6.470	371	59,1%	215	x	301	x	301	x	301	x	301	x	301	x	301	x	301	x
11	6.164	118	6.046	391	0,0%	0	x	118	x	118	x	118	x	118	x	118	x	118	x	118	x
12	5.762	148	5.614	389	57,6%	224	x	373	x	373	x	373	x	373	x	373	x	373	x	373	x
13	5.368	176	5.183	395	0,0%	0	x	176	x	176	x	176	x	176	x	176	x	176	x	176	x
14	4.959	199	4.759	398	57,2%	228	x	427	x	427	x	427	x	427	x	427	x	427	x	427	x
15	4.569	219	4.350	399	0,0%	0	x	219	x	219	x	219	x	219	x	219	x	219	x	219	x
16	4.193	236	3.958	398	56,7%	226	x	461	x	461	x	461	x	461	x	461	x	461	x	461	x
17	3.834	248	3.586	395	0,0%	0	x	248	x	248	x	248	x	248	x	248	x	248	x	248	x
18	3.493	256	3.237	390	56,4%	220	x	476	x	476	x	476	x	476	x	476	x	476	x	476	x
19	3.172	261	2.911	384	0,0%	0	x	261	x	261	x	261	x	261	x	261	x	261	x	261	x
20	2.871	263	2.608	375	56,1%	210	x	474	x	474	x	474	x	474	x	474	x	474	x	474	x
21	2.592	262	2.329	365	0,0%	0	x	262	x	262	x	262	x	262	x	262	x	262	x	262	x
22	2.332	259	2.074	354	55,9%	198	x	456	x	456	x	456	x	456	x	456	x	456	x	456	x
23	2.093	253	1.841	343	0,0%	0	x	253	x	253	x	253	x	253	x	253	x	253	x	253	x
24	1.874	245	1.629	328	55,1%	184	x	429	x	429	x	429	x	429	x	429	x	429	x	429	x
	130.365	3.112	127.263	8.180		2.438		5549		5346		5018		4818		4602		4378		4150	
Potential bezogen auf alle Unfälle mit Personenschaden																3,70%	3,53%	3,36%	3,18%		

Anhang 18: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Getöteten im Jahr 2035 nach Szenario B



Anhang 19: - PKW Hauptverursacher von Unfällen mit Getöteten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario B

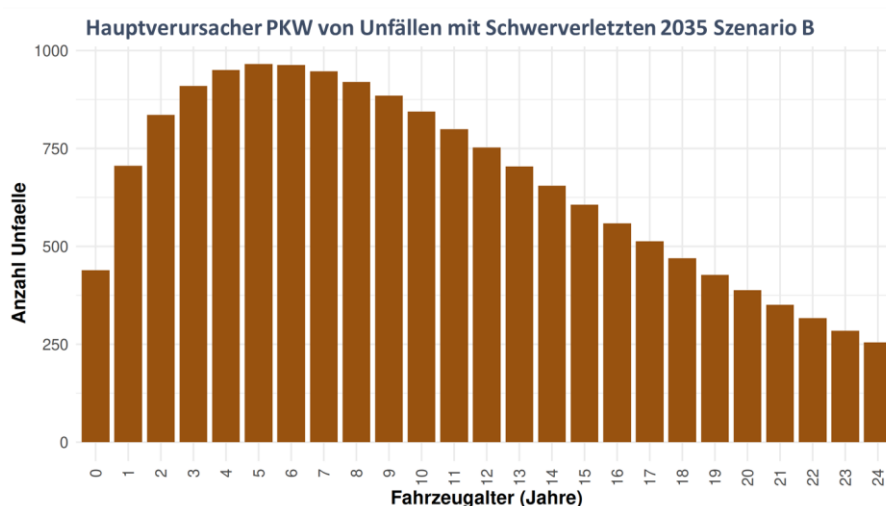
**Unfälle mit Getöteten von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario B**

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	21	2,2%	0	20
1	36	2,4%	1	35
2	44	2,6%	1	42
3	49	2,9%	1	47
4	52	3,2%	2	50
5	54	3,5%	2	52
6	54	3,9%	2	52
7	54	4,3%	2	52
8	53	4,7%	3	51
9	52	5,2%	3	49
10	50	5,7%	3	47
11	47	6,3%	3	44
12	45	6,9%	3	42
13	42	7,6%	3	39
14	40	8,4%	3	37
15	37	9,2%	3	34
16	34	10,1%	3	31
17	32	11,0%	4	28
18	29	12,1%	4	26
19	27	13,2%	4	23
20	24	14,4%	4	21
21	22	15,7%	3	19
22	20	17,1%	3	17
23	18	18,6%	3	15
24	16	20,1%	3	13
Summen	951		67	884

Anhang 20: - Ergebnisse Szenario B Unfälle mit Getöteten

Reduktionspotential von PKW verursachten Unfällen mit Getöteten im Jahr 2035 Szenario B durch jährliche Hauptuntersuchungen														
Alter	VKU GE verursacht von PKW gesamt	Veränderung VKU GE durch Außerbetrieb- setzungen	VKU GE verursacht von PKW gesamt ohne Außerbetriebsetzungen	VKU GE verursacht von PKW mit unfallelevanten Mängeln	Reduktions- potential in %	Reduktion VKU GE verursacht von PKW mit unfallelevanten Mängeln	HU Untersuchungsfrist 1/1/1... (jährlich)	HU Untersuchungsfrist 3/1/1... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/1... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/1... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/1... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1... (ab 16 jährlich)	
0	21	0	21	0	0,0%	0	x	0	0	0	0	0	0	
1	36	0	36	1	54,2%	0	x	1	0	0	0	0	0	
2	43	0	44	1	64,4%	1	x	1	0	0	0	0	0	
3	48	0	49	1	0,0%	0	x	0	x	0	x	0	x	
4	51	0	52	2	58,9%	1	x	1	0	0	0	0	0	
5	53	0	54	2	0,0%	0	x	0	x	0	x	0	x	
6	54	0	54	2	58,8%	1	x	1	1	1	0	0	0	
7	54	0	54	2	0,0%	0	x	0	x	0	x	0	x	
8	53	0	53	3	58,5%	1	x	2	2	2	2	0	0	
9	52	0	52	3	0,0%	0	x	0	x	0	x	0	x	
10	50	1	50	3	58,1%	2	x	2	2	2	2	1	1	
11	48	1	47	3	0,0%	0	x	1	1	1	1	1	1	
12	46	1	45	3	57,6%	2	x	3	3	3	3	1	1	
13	44	1	42	3	0,0%	0	x	1	1	1	1	1	1	
14	41	1	40	3	57,2%	2	x	3	3	3	3	3	1	
15	39	2	37	3	0,0%	0	x	2	2	2	2	2	2	
16	36	2	34	3	56,7%	2	x	4	4	4	4	4	4	
17	34	2	32	4	0,0%	0	x	2	2	2	2	2	2	
18	31	2	29	4	56,4%	2	x	4	4	4	4	4	4	
19	29	2	27	4	0,0%	0	x	2	2	2	2	2	2	
20	27	2	24	4	56,1%	2	x	4	4	4	4	4	4	
21	24	2	22	3	0,0%	0	x	2	2	2	2	2	2	
22	22	2	20	3	55,9%	2	x	4	4	4	4	4	4	
23	20	2	18	3	0,0%	0	x	2	2	2	2	2	2	
24	18	2	16	3	56,1%	2	x	4	4	4	4	2	2	
976	25	951	67	20	4,59%	44	4,37%	41	38	36	34	32	32	
Potential bezogen auf alle Unfälle mit Getöteten													3,51%	3,31%

Anhang 21: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Schwerverletzten im Jahr 2035
nach Szenario B



Anhang 22: - PKW Hauptverursacher von Unfällen mit Schwerverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach
Szenario B

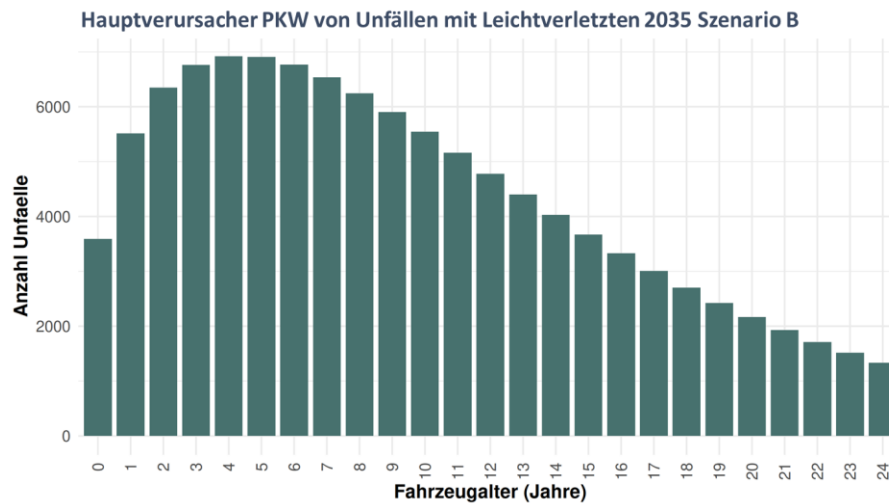
Unfälle mit Schwerverletzten von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario B

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	439	2,2%	9	430
1	706	2,4%	17	689
2	835	2,6%	22	813
3	910	2,9%	26	884
4	950	3,2%	30	920
5	966	3,5%	34	932
6	963	3,9%	37	926
7	947	4,3%	41	906
8	920	4,7%	43	876
9	885	5,2%	46	839
10	844	5,7%	48	796
11	800	6,3%	50	749
12	752	6,9%	52	700
13	704	7,6%	54	650
14	655	8,4%	55	600
15	607	9,2%	56	551
16	559	10,1%	56	503
17	513	11,0%	57	457
18	469	12,1%	57	413
19	427	13,2%	56	371
20	388	14,4%	56	332
21	351	15,7%	55	296
22	317	17,1%	54	262
23	285	18,6%	53	232
24	255	20,1%	51	204
Summen	16.448		1.117	15.331

Anhang 23: - Ergebnisse Szenario B Unfälle mit Schwerverletzten

Reduktionspotential von PKWverursachten Unfällen mit Schwerverletzten im Jahr 2035 Szenario B durch jährliche Hauptuntersuchungen																
Alter	VKU SV verursacht von PKW gesamt	Veränderung VKU SV durch Außerbetrieb- setzungen	VKU SV verursacht von PKW gesamt ohne Außerbetriebssetzungen	VKU SV verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU SV verursacht von PKW mit unfallrelevanten Mängeln	HU 1/1/1/... (jährlich)	HU 3/1/1/... (ab 4 jährlich)	HU 3/2/1/... (ab 6 jährlich)	HU 3/2/2/1/... (ab 10 jährlich)	HU 3/2/2/2/1/... (ab 12 jährlich)	HU 3/2/2/2/2/1/... (ab 14 jährlich)	HU 3/2/2/2/2/2/1/... (ab 16 jährlich)			
0	448	9	439	9	0,0%	0	x	9	9	9	9	9	9			
1	707	1	706	17	54,2%	9	x	10	1	1	1	1	1			
2	831	-4	835	22	64,4%	14	x	10	-4	-4	-4	-4	-4			
3	903	-7	910	26	0,0%	0	x	-7	x	-7	x	-7	x			
4	942	-8	950	30	58,9%	18	x	10	x	-8	-8	-8	-8			
5	959	-7	966	34	0,0%	0	x	-7	x	-7	x	-7	x			
6	958	-5	963	37	58,8%	22	x	17	x	17	x	-5	-5			
7	945	-2	947	41	0,0%	0	x	-2	x	-2	x	-2	x			
8	921	2	920	43	58,5%	25	x	27	x	27	x	2	2			
9	890	5	885	46	0,0%	0	x	5	x	5	x	5	x			
10	854	10	844	48	58,1%	28	x	38	x	38	x	10	10			
11	813	14	800	50	0,0%	0	x	14	x	14	x	14	x			
12	770	18	752	52	57,6%	30	x	48	x	48	x	48	x			
13	725	21	704	54	0,0%	0	x	21	x	21	x	21	x			
14	680	25	655	55	57,2%	31	x	56	x	56	x	56	x			
15	634	28	607	56	0,0%	0	x	28	x	28	x	28	x			
16	589	30	559	56	56,7%	32	x	62	x	62	x	62	x			
17	546	32	513	57	0,0%	0	x	32	x	32	x	32	x			
18	503	34	469	57	56,4%	32	x	66	x	66	x	66	x			
19	463	35	427	56	0,0%	0	x	35	x	35	x	35	x			
20	424	36	388	56	56,1%	31	x	67	x	67	x	67	x			
21	388	36	351	55	0,0%	0	x	36	x	36	x	36	x			
22	353	37	317	54	55,9%	30	x	67	x	67	x	67	x			
23	321	36	285	53	0,0%	0	x	36	x	36	x	36	x			
24	291	36	255	51	56,1%	29	x	64	x	64	x	64	x			
16.860	413	16.448	1.117	332		745	722	704	682	656	628	598	567			
Potential bezogen auf alle Unfälle mit Schwerverletzten													3,36%	3,55%		
													3,73%	3,89%		
													4,04%	4,17%		
													4,28%	4,42%		

Anhang 24: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Leichtverletzten im Jahr 2035 nach Szenario B



Anhang 25: - PKW Hauptverursacher von Unfällen mit Leichtverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario B

Unfälle mit Leichtverletzten von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario B

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	3.591	2,2%	77	3.514
1	5.512	2,4%	131	5.381
2	6.346	2,6%	167	6.180
3	6.763	2,9%	196	6.567
4	6.923	3,2%	221	6.702
5	6.909	3,5%	244	6.665
6	6.769	3,9%	263	6.505
7	6.538	4,3%	281	6.258
8	6.245	4,7%	295	5.949
9	5.908	5,2%	308	5.600
10	5.543	5,7%	318	5.225
11	5.164	6,3%	326	4.838
12	4.780	6,9%	332	4.449
13	4.400	7,6%	335	4.064
14	4.028	8,4%	337	3.691
15	3.670	9,2%	337	3.333
16	3.329	10,1%	335	2.994
17	3.007	11,0%	331	2.675
18	2.705	12,1%	326	2.379
19	2.425	13,2%	320	2.105
20	2.166	14,4%	312	1.854
21	1.928	15,7%	302	1.626
22	1.711	17,1%	292	1.419
23	1.514	18,6%	281	1.233
24	1.335	20,1%	269	1.066
Summen	109.209		6.936	102.273

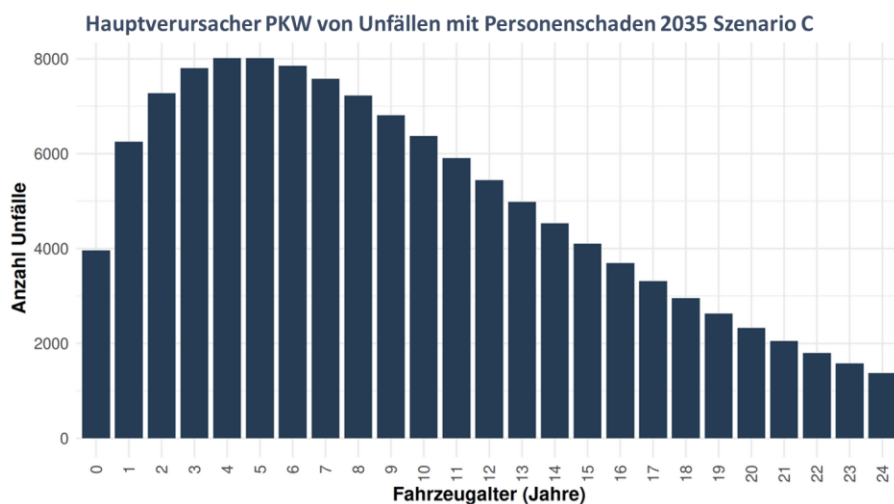
Anhang 26: - Ergebnisse Szenario B Unfälle mit Leichtverletzten

Reduktionspotential von PKW verursachten Unfällen mit Leichtverletzten im Jahr 2035 Szenario B durch jährliche Hauptuntersuchungen																
Alter	VKULV verursacht von PKW gesamt	Veränderung VKULV durch Außenbetriebs- setzungen	VKULV verursacht von PKW gesamt ohne Außenbetriebssetzungen	VKULV verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKULV verursacht von PKW mit unfallrelevanten Mängeln	HU Untersuchungsfrist 1/1/1/... (jährlich)	HU Untersuchungsfrist 31/1/1/... (ab 4 jährlich)	HU Untersuchungsfrist 32/1/1/... (ab 5 jährlich)	HU Untersuchungsfrist 3/2/1/1/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/2/1/1/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/1/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/1/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1/1/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/1/1/... (ab 16 jährlich)	
0	3.663	71	3.591	77	0,0%		71		71		71		71		71	
1	5.517	5	5.512	131	54,2%	71	x	76	5	5	5	5	5	5	5	
2	6.310	-36	6.346	167	64,4%	107	x	71		-36	-36	-36	-36	-36	-36	
3	6.707	-56	6.763	196	0,0%		x	-56	x	-56	x	-56	x	-56	x	
4	6.864	-59	6.923	221	59,9%	130	x	72	x	72	-59	-59	-59	-59	-59	
5	6.859	-50	6.909	244	0,0%	0	x	-50	x	-50	x	-50	x	-50	x	
6	6.736	-33	6.769	263	58,8%	155	x	122	x	122	-33	-33	-33	-33	-33	
7	6.529	-9	6.538	281	0,0%	281	x	-9	x	-9	x	-9	x	-9	x	
8	6.263	18	6.245	295	58,5%	173	x	191	x	191	x	18	18	18	18	
9	5.955	47	5.908	308	0,0%	0	x	47	x	47	x	47	x	47	x	
10	5.619	76	5.543	318	58,1%	185	x	261	x	261	x	261	x	76	76	
11	5.268	104	5.164	326	0,0%	0	x	104	x	104	x	104	x	104	104	
12	4.910	130	4.780	332	57,6%	191	x	320	x	320	x	320	x	320	130	
13	4.552	153	4.400	335	0,0%	0	x	153	x	153	x	153	x	153	153	
14	4.201	172	4.028	337	57,2%	193	x	365	x	365	x	365	x	365	172	
15	3.859	189	3.670	337	0,0%	0	x	189	x	189	x	189	x	189	189	
16	3.531	202	3.329	335	56,7%	190	x	392	x	392	x	392	x	392	392	
17	3.219	212	3.007	331	0,0%	0	x	212	x	212	x	212	x	212	212	
18	2.924	218	2.705	326	56,4%	184	x	402	x	402	x	402	x	402	402	
19	2.647	222	2.425	320	0,0%	0	x	222	x	222	x	222	x	222	222	
20	2.389	223	2.166	312	56,1%	175	x	397	x	397	x	397	x	397	397	
21	2.149	221	1.928	302	0,0%	0	x	221	x	221	x	221	x	221	221	
22	1.928	217	1.711	292	55,9%	163	x	381	x	381	x	381	x	381	381	
23	1.725	212	1.514	281	0,0%	0	x	212	x	212	x	212	x	212	212	
24	1.540	205	1.335	269	56,1%	151	x	355	x	355	x	355	x	355	355	
	111.863	2.654	109.209	6.936		2.068	4722	4544	4413	4258	4086	3901	3710	3517	3317	
Potential bezogen auf alle Unfälle mit Leichtverletzten							4,22%	4,06%	3,95%	3,81%	3,65%	3,49%	3,32%	3,14%		

Anhang 27: - Übersicht Reduktionspotentiale Verkehrsunfälle nach Szenario B

Reduktionspotential von PKW verursachten Unfällen 2035 Szenario B durch jährliche Hauptuntersuchungen										
Unfallkategorie	Anzahl Unfälle 2035 gesamt	HU Untersuchungsfrist 1/1/1/... (jährlich)	HU Untersuchungsfrist 3/1/1/... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1/... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/2/1/... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/2/1/... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1/... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/1/... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/2/2/1/... (ab 16 jährlich)	
Unfälle mit Personenschaden	130.365	-5549 -4,3%	-5346 -4,1%	-5197 -4,0%	-5018 -3,8%	-4818 -3,7%	-4602 -3,5%	-4378 -3,4%	-4150 -3,2%	
Unfälle mit Getöteten	976	-45 -4,6%	-44 -4,5%	-43 -4,4%	-41 -4,2%	-38 -3,9%	-36 -3,7%	-34 -3,5%	-32 -3,3%	
Unfälle mit Schwerverletzten	16.860	-745 -4,4%	-722 -4,3%	-704 -4,2%	-682 -4,0%	-656 -3,9%	-628 -3,7%	-598 -3,5%	-567 -3,4%	
Unfälle mit Leichtverletzten	111.863	-4722 -4,2%	-4544 -4,1%	-4413 -3,9%	-4258 -3,8%	-4086 -3,7%	-3901 -3,5%	-3710 -3,3%	-3517 -3,1%	

Anhang 28: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Personenschaden im Jahr 2035
nach Szenario C



Anhang 29: - PKW Hauptverursacher von Unfällen mit Personenschaden - Aufteilung mit/ohne unfallrelevante Mängel
nach Szenario C

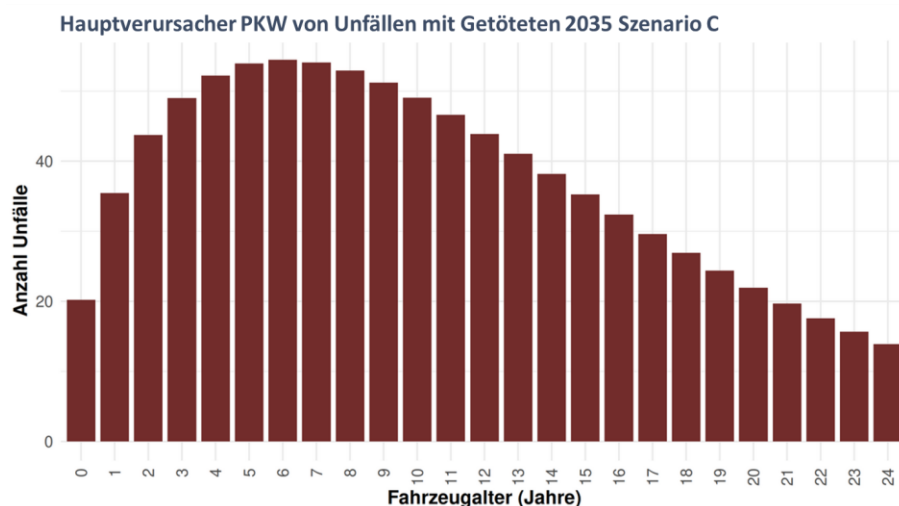
**Unfälle mit Personenschaden von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario C**

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	3.963	2,2%	86	3.877
1	6.249	2,4%	150	6.100
2	7.277	2,6%	192	7.085
3	7.804	2,9%	227	7.577
4	8.018	3,2%	258	7.760
5	8.013	3,5%	284	7.729
6	7.852	3,9%	306	7.545
7	7.577	4,3%	326	7.251
8	7.222	4,7%	342	6.880
9	6.813	5,2%	355	6.458
10	6.370	5,7%	365	6.005
11	5.908	6,3%	372	5.536
12	5.442	6,9%	377	5.065
13	4.981	7,6%	379	4.602
14	4.532	8,4%	378	4.154
15	4.102	9,2%	375	3.727
16	3.694	10,1%	370	3.324
17	3.311	11,0%	363	2.948
18	2.955	12,1%	354	2.601
19	2.626	13,2%	344	2.282
20	2.324	14,4%	332	1.993
21	2.050	15,7%	319	1.731
22	1.801	17,1%	305	1.496
23	1.577	18,6%	290	1.287
24	1.376	20,1%	275	1.102
Summen	123.839		7.722	116.117

Anhang 30: - Ergebnisse Szenario C Unfälle mit Personenschaden

Reduktionspotential von PKW-verseuchten Unfällen mit Personenschaden im Jahr 2035 Szenario C durch jährliche Hauptuntersuchungen														
Alter	VKU PS verseucht von PKW gesamt	Veränderung VKU PS durch Außerbetrieb- setzungen	VKU PS verseucht von PKW gesamt ohne Außerbetriebsetzungen	VKU PS verseucht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU PS mit unfallrelevanten Mängeln	HU 1/1/1/... (jährlich)	Untersuchungsfrist 3/1/1/... (ab 4 jährlich)	HU 3/2/2/1/... (ab 6 jährlich)	Untersuchungsfrist 3/2/2/1/... (ab 8 jährlich)	HU 3/2/2/1/... (ab 10 jährlich)	Untersuchungsfrist 3/2/2/2/1/... (ab 12 jährlich)	HU 3/2/2/2/1/... (ab 14 jährlich)	HU 3/2/2/2/2/1/... (ab 16 jährlich)
0	4.135	172	3.963	86	0,0%	0	x	172	172	172	172	172	172	172
1	6.265	16	6.249	150	54,2%	81	x	97	16	16	16	16	16	16
2	7.192	-85	7.277	192	64,4%	124	x	39	-85	-85	-85	-85	-85	-85
3	7.669	-135	7.804	227	0,0%	0	x	-135	x	-135	x	-135	x	-135
4	7.873	-145	8.018	258	58,9%	152	x	7	x	7	x	-145	-145	-145
5	7.889	-125	8.013	284	0,0%	0	x	-125	x	-125	x	-125	x	-125
6	7.770	-82	7.852	306	58,8%	180	x	98	x	98	x	-82	-82	-82
7	7.553	-24	7.577	326	0,0%	0	x	-24	x	-24	x	-24	x	-24
8	7.266	43	7.222	342	58,5%	200	x	243	x	243	x	43	43	43
9	6.928	115	6.813	355	0,0%	0	x	115	x	115	x	115	x	115
10	6.556	187	6.370	365	58,1%	212	x	399	x	399	x	187	187	187
11	6.164	256	5.908	372	0,0%	0	x	256	x	256	x	256	x	256
12	5.762	320	5.442	377	57,6%	217	x	537	x	537	x	537	x	320
13	5.358	377	4.981	379	0,0%	0	x	377	x	377	x	377	x	377
14	4.959	427	4.532	378	57,2%	216	x	643	x	643	x	643	x	427
15	4.569	467	4.102	375	0,0%	0	x	467	x	467	x	467	x	467
16	4.193	499	3.694	370	56,7%	210	x	709	x	709	x	709	x	709
17	3.834	523	3.311	363	0,0%	0	x	523	x	523	x	523	x	523
18	3.493	538	2.955	354	56,4%	200	x	738	x	738	x	738	x	738
19	3.172	546	2.626	344	0,0%	0	x	546	x	546	x	546	x	546
20	2.871	547	2.324	332	56,1%	186	x	733	x	733	x	733	x	733
21	2.592	542	2.050	319	0,0%	0	x	542	x	542	x	542	x	542
22	2.332	531	1.801	305	55,9%	170	x	702	x	702	x	702	x	702
23	2.093	516	1.577	290	0,0%	0	x	516	x	516	x	516	x	516
24	1.874	498	1.376	275	56,1%	154	x	652	x	652	x	652	x	652
130.365	6.626		123.839	7.722		2.302	8828	8623	8471	8291	8091	7879	7662	7446
Potential bezogen auf alle Unfälle mit Personenschaden							6,77%	6,61%	6,50%	6,36%	6,21%	5,89%	5,71%	5,71%
														5,88%

Anhang 31: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Getöteten im Jahr 2035 nach Szenario C



Anhang 32: - PKW Hauptverursacher von Unfällen mit Getöteten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario C

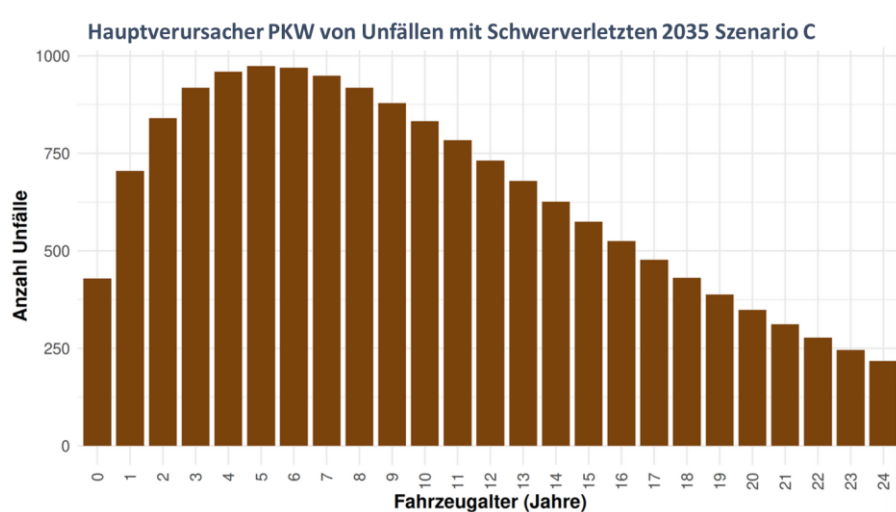
Unfälle mit Getöteten von Hauptverursachern PKW über das Fahrzeugalter im Jahr 2035 Szenario C

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	20	2,2%	0	20
1	35	2,4%	1	35
2	44	2,6%	1	43
3	49	2,9%	1	48
4	52	3,2%	2	51
5	54	3,5%	2	52
6	54	3,9%	2	52
7	54	4,3%	2	52
8	53	4,7%	3	50
9	51	5,2%	3	49
10	49	5,7%	3	46
11	47	6,3%	3	44
12	44	6,9%	3	41
13	41	7,6%	3	38
14	38	8,4%	3	35
15	35	9,2%	3	32
16	32	10,1%	3	29
17	30	11,0%	3	26
18	27	12,1%	3	24
19	24	13,2%	3	21
20	22	14,4%	3	19
21	20	15,7%	3	17
22	18	17,1%	3	15
23	16	18,6%	3	13
24	14	20,1%	3	11
Summen	923		63	860

Anhang 33: - Ergebnisse Szenario C Unfälle mit Getöteten

Reduktionspotential von PKW verursachten Unfällen mit Getöteten im Jahr 2035 Szenario C durch jährliche Hauptuntersuchungen														
Alter	VKU GE verursacht von PKW gesamt	Veränderung VKU GE durch Außerbetrieb- setzungen	VKU GE verursacht von PKW gesamt ohne Außerbetriebsetzungen	VKU GE verursacht von PKW mit unfallelevanten Mängeln	Reduktions- potential in %	Reduktion VKU GE verursacht von PKW mit unfallelevanten Mängeln	HU Untersuchungsfrist 1/1/1... (jährlich)	HU Untersuchungsfrist 3/1/1... (ab 4 jährlich)	HU Untersuchungsfrist 3/2/1... (ab 6 jährlich)	HU Untersuchungsfrist 3/2/2/1... (ab 8 jährlich)	HU Untersuchungsfrist 3/2/2/1... (ab 10 jährlich)	HU Untersuchungsfrist 3/2/2/2/1... (ab 12 jährlich)	HU Untersuchungsfrist 3/2/2/2/1... (ab 14 jährlich)	HU Untersuchungsfrist 3/2/2/2/2/1... (ab 16 jährlich)
0	21	1	20	0	0,0%	0	x	1	1	1	1	1	1	1
1	36	0	35	1	54,2%	0	x	1	0	0	0	0	0	0
2	43	0	44	1	64,4%	1	x	0	0	0	0	0	0	0
3	48	-1	49	1	0,0%	0	x	-1	x	-1	x	-1	x	-1
4	51	-1	52	2	58,9%	1	x	0	x	0	-1	-1	-1	-1
5	53	-1	54	2	0,0%	0	x	-1	x	-1	x	-1	x	-1
6	54	-1	54	2	58,8%	1	x	1	x	1	-1	-1	-1	-1
7	54	0	54	2	0,0%	0	x	0	x	0	0	0	0	0
8	53	0	53	3	58,5%	1	x	2	x	2	x	2	0	0
9	52	1	51	3	0,0%	0	x	1	x	1	x	1	x	1
10	50	1	49	3	58,1%	2	x	3	x	3	x	3	1	1
11	48	2	47	3	0,0%	0	x	2	x	2	x	2	x	2
12	46	2	44	3	57,6%	2	x	4	x	4	x	4	2	2
13	44	3	41	3	0,0%	0	x	3	x	3	x	3	x	3
14	41	3	38	3	57,2%	2	x	5	x	5	x	5	5	3
15	39	4	35	3	0,0%	0	x	4	x	4	x	4	x	4
16	36	4	32	3	56,7%	2	x	6	x	6	x	6	x	6
17	34	4	30	3	0,0%	0	x	4	x	4	x	4	x	4
18	31	4	27	3	56,4%	2	x	6	x	6	x	6	x	6
19	29	5	24	3	0,0%	0	x	5	x	5	x	5	x	5
20	27	5	22	3	56,1%	2	x	6	x	6	x	6	x	6
21	24	5	20	3	0,0%	0	x	5	x	5	x	5	x	5
22	22	5	18	3	55,9%	2	x	6	x	6	x	6	x	6
23	20	5	16	3	0,0%	0	x	5	x	5	x	5	x	5
24	18	5	14	3	56,1%	2	x	6	x	6	x	2	x	2
976	53	923	63	19		71	70	69	68	62	60	58	57	57
Potential bezogen auf alle Unfälle mit Getöteten							7,31%	7,19%	7,09%	6,96%	6,34%	6,17%	5,99%	5,81%

Anhang 34: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Schwerverletzten im Jahr 2035
nach Szenario C



Anhang 35: - PKW Hauptverursacher von Unfällen mit Schwerverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach
Szenario C

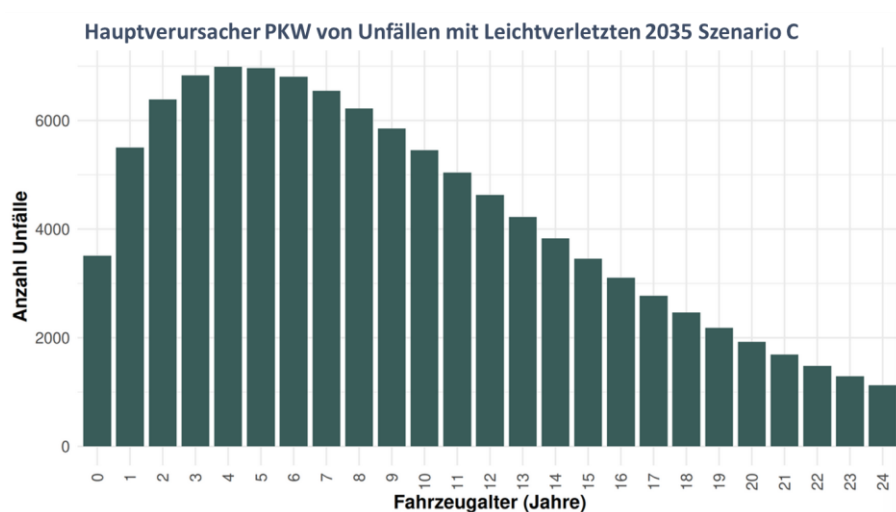
Unfälle mit Schwerverletzten von Hauptverursachern PKW über das Fahrzeugalter
im Jahr 2035 Szenario C

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	429	2,2%	9	420
1	705	2,4%	17	688
2	840	2,6%	22	818
3	918	2,9%	27	891
4	959	3,2%	31	928
5	974	3,5%	35	940
6	969	3,9%	38	931
7	949	4,3%	41	908
8	918	4,7%	43	874
9	878	5,2%	46	833
10	833	5,7%	48	785
11	783	6,3%	49	734
12	732	6,9%	51	681
13	679	7,6%	52	627
14	626	8,4%	52	574
15	575	9,2%	53	522
16	525	10,1%	53	472
17	477	11,0%	52	424
18	431	12,1%	52	380
19	388	13,2%	51	338
20	348	14,4%	50	299
21	311	15,7%	48	263
22	277	17,1%	47	230
23	246	18,6%	45	201
24	218	20,1%	43	174
Summen	15.990		1.053	14.936

Anhang 36: - Ergebnisse Szenario C Unfälle mit Schwerverletzten

Reduktionspotential von PKW-Verursachern Unfällen mit Schwerverletzten im Jahr 2035 Szenario C durch jährliche Hauptuntersuchungen															
Alter	VKU SV verursacht von PKW gesamt	Veränderung VKU SV durch Außerbetrieb- setzungen	VKU SV verursacht von PKW gesamt ohne Außerbetriebsetzungen	VKU SV verursacht von PKW mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion VKU SV verursacht von PKW mit unfallrelevanten Mängeln	HU 11/11 (jährlich)	HU 31/11 (ab 4. jährlich)	HU 30/11 (ab 5. jährlich)	HU 3/2/11 (ab 6. jährlich)	HU 3/2/21 (ab 8. jährlich)	HU 3/2/21 (ab 10. jährlich)	HU 3/2/22/21 (ab 12. jährlich)	HU 3/2/22/21 (ab 14. jährlich)	HU 3/2/22/21 (ab 16. jährlich)
0	448	19	429	9	0,0%	0	19	19	19	19	19	19	19	19	19
1	707	3	705	17	54,2%	9	12	3	3	3	3	3	3	3	3
2	831	-9	840	22	64,4%	14	6	-9	-9	-9	-9	-9	-9	-9	-9
3	903	-15	918	27	0,0%	0	-15	x	-15	x	-15	x	-15	x	-15
4	942	-17	959	31	58,9%	18	1	1	-17	-17	-17	-17	-17	-17	-17
5	959	-15	974	35	0,0%	0	-15	x	-15	x	-15	x	-15	x	-15
6	958	-11	969	38	58,8%	22	11	11	11	11	-11	-11	-11	-11	-11
7	945	-4	949	41	0,0%	0	-4	x	-4	x	-4	x	-4	x	-4
8	921	3	918	43	58,5%	25	29	x	29	x	29	3	3	3	3
9	890	12	878	46	0,0%	0	12	x	12	x	12	x	12	x	12
10	854	21	833	48	58,1%	28	49	x	49	x	49	x	49	x	49
11	813	30	783	49	0,0%	0	30	x	30	x	30	x	30	x	30
12	770	38	732	51	57,6%	29	68	x	68	x	68	x	68	x	68
13	725	46	679	52	0,0%	0	46	x	46	x	46	x	46	x	46
14	680	53	626	52	57,2%	30	83	x	83	x	83	x	83	x	83
15	634	60	575	53	0,0%	0	60	x	60	x	60	x	60	x	60
16	589	65	525	53	56,7%	30	95	x	95	x	95	x	95	x	95
17	546	69	477	52	0,0%	0	69	x	69	x	69	x	69	x	69
18	503	72	431	52	56,4%	29	101	x	101	x	101	x	101	x	101
19	463	74	388	51	0,0%	0	74	x	74	x	74	x	74	x	74
20	424	76	348	50	56,1%	28	104	x	104	x	104	x	104	x	104
21	388	76	311	48	0,0%	0	76	x	76	x	76	x	76	x	76
22	353	76	277	47	55,9%	26	102	x	102	x	102	x	102	x	102
23	321	75	246	45	0,0%	0	75	x	75	x	75	x	75	x	75
24	291	73	218	43	56,1%	24	97	x	97	x	97	x	97	x	97
16.860	871	15.990	1.053	313			1184	1161	1143	1120	1095	1067	1038	1008	5,98%
Potential bezogen auf alle Unfälle mit Schwerverletzten							7,02%	6,88%	6,78%	6,55%	6,49%	6,33%	6,16%	5,98%	

Anhang 37: - modellierte Altersverteilung der Hauptverursacher PKW von Unfällen mit Leichtverletzten im Jahr 2035 nach Szenario C



Anhang 38: - PKW Hauptverursacher von Unfällen mit Leichtverletzten - Aufteilung mit/ohne unfallrelevante Mängel nach Szenario C

Unfälle mit Leichtverletzten von Hauptverursachern PKW über das Fahrzeugalter im Jahr 2035 Szenario C

Alter	Unfälle gesamt	Anteil unfallrelevanter Mängel	Unfälle mit unfallrelevanten Mängeln	Unfälle ohne unfallrelevante Mängel
0	3.510	2,2%	76	3.434
1	5.505	2,4%	132	5.373
2	6.386	2,6%	169	6.218
3	6.826	2,9%	199	6.628
4	6.992	3,2%	225	6.767
5	6.967	3,5%	247	6.720
6	6.806	3,9%	266	6.540
7	6.548	4,3%	282	6.267
8	6.223	4,7%	295	5.928
9	5.852	5,2%	305	5.547
10	5.454	5,7%	313	5.142
11	5.044	6,3%	318	4.726
12	4.631	6,9%	321	4.310
13	4.225	7,6%	321	3.904
14	3.832	8,4%	320	3.513
15	3.457	9,2%	316	3.141
16	3.103	10,1%	311	2.792
17	2.772	11,0%	304	2.469
18	2.466	12,1%	295	2.170
19	2.184	13,2%	286	1.898
20	1.927	14,4%	275	1.652
21	1.693	15,7%	263	1.430
22	1.483	17,1%	251	1.232
23	1.294	18,6%	238	1.056
24	1.125	20,1%	224	901
Summen	106.305		6.549	99.756

Anhang 39: - Ergebnisse Szenario C Unfälle mit Leichtverletzten

Reduktionspotential von PKW-versehrten Unfällen mit Leichtverletzten im Jahr 2035 Szenario C durch jährliche Hauptuntersuchungen														
Alter	WK LV versehrten gesamt	Veränderung WK LV durch Außenbetriebs- setzungen	WK LV versehrten gesamt ohne Außenbetriebssetzungen	WK LV versehrten mit unfallrelevanten Mängeln	Reduktions- potential in %	Reduktion WK LV versehrten mit unfallrelevanten Mängeln	HU Untersuchungsfrist 11/11/... (jährlich)	HU Untersuchungsfrist 31/11/... (ab 4 jährlich)	HU Untersuchungsfrist 32/11/... (ab 6 jährlich)	HU Untersuchungsfrist 32/21/... (ab 8 jährlich)	HU Untersuchungsfrist 32/22/21/... (ab 10 jährlich)	HU Untersuchungsfrist 32/22/21/... (ab 12 jährlich)	HU Untersuchungsfrist 32/22/21/... (ab 14 jährlich)	HU Untersuchungsfrist 32/22/22/21/... (ab 16 jährlich)
0	3.663	153	3.510	76	0,0%	0	x	153	153	153	153	153	153	153
1	5.517	13	5.505	132	54,2%	71	x	84	13	13	13	13	13	13
2	6.310	-76	6.386	169	64,4%	109	x	32	-76	-76	-76	-76	-76	-76
3	6.707	-119	6.826	199	0,0%	0	x	-119	x	-119	x	-119	x	-119
4	6.864	-127	6.992	225	58,9%	132	x	5	5	-127	-127	-127	-127	-127
5	6.859	-108	6.967	247	0,0%	0	x	-108	x	-108	x	-108	x	-108
6	6.736	-70	6.806	266	58,8%	156	x	86	x	86	x	-70	-70	-70
7	6.529	-19	6.548	282	0,0%	0	x	-19	x	-19	x	-19	x	-19
8	6.263	40	6.223	295	58,5%	172	x	213	x	213	x	40	40	40
9	5.955	103	5.852	305	0,0%	0	x	103	x	103	x	103	x	103
10	5.619	165	5.454	313	58,1%	182	x	347	x	347	x	165	165	165
11	5.268	224	5.044	318	0,0%	0	x	224	x	224	x	224	x	224
12	4.910	279	4.631	321	57,6%	185	x	463	x	463	x	463	x	279
13	4.552	327	4.225	321	0,0%	0	x	327	x	327	x	327	x	327
14	4.201	368	3.832	320	57,2%	183	x	551	x	551	x	551	x	368
15	3.859	402	3.457	316	0,0%	0	x	402	x	402	x	402	x	402
16	3.531	428	3.103	311	56,7%	176	x	604	x	604	x	604	x	604
17	3.219	446	2.772	304	0,0%	0	x	446	x	446	x	446	x	446
18	2.924	458	2.466	295	56,4%	167	x	624	x	624	x	624	x	624
19	2.647	463	2.184	286	0,0%	0	x	463	x	463	x	463	x	463
20	2.389	462	1.927	275	56,1%	154	x	616	x	616	x	616	x	616
21	2.149	456	1.693	263	0,0%	0	x	456	x	456	x	456	x	456
22	1.928	445	1.483	251	55,9%	140	x	586	x	586	x	586	x	586
23	1.725	431	1.294	238	0,0%	0	x	431	x	431	x	431	x	431
24	1.540	414	1.125	224	56,1%	126	x	540	x	540	x	540	x	540
111.863	5.559		106.305	6.549		1.963	7512	7332	7200	7043	6871	6689	6505	6322
Potential bezogen auf alle Unfälle mit Leichtverletzten														
							6,72%	6,55%	6,44%	6,30%	6,14%	5,95%	5,82%	5,65%

Anhang 40: - Übersicht Reduktionspotentiale Verkehrsunfälle nach Szenario C

Reduktionspotential von PKW verursachten Unfällen 2035 Szenario C durch jährliche Hauptuntersuchungen																	
Unfallkategorie	Anzahl Unfälle 2035 gesamt	HU Untersuchungsfrist 1/1/1/... (jährlich)		HU Untersuchungsfrist 3/1/1/... (ab 4 jährlich)		HU Untersuchungsfrist 3/2/1/... (ab 6 jährlich)		HU Untersuchungsfrist 3/2/2/1/... (ab 8 jährlich)		HU Untersuchungsfrist 3/2/2/2/1/... (ab 10 jährlich)		HU Untersuchungsfrist 3/2/2/2/2/1/... (ab 12 jährlich)		HU Untersuchungsfrist 3/2/2/2/2/2/1/... (ab 14 jährlich)		HU Untersuchungsfrist 3/2/2/2/2/2/2/1/... (ab 16 jährlich)	
		-8828	-6,8%	-8623	-6,6%	-8471	-6,5%	-8291	-6,4%	-8091	-6,3%	-7879	-6,0%	-7662	-5,9%	-7446	-5,7%
Unfälle mit Personenschaden	130.365	-71	-7,3%	-70	-7,2%	-69	-7,1%	-68	-7,0%	-62	-6,3%	-60	-6,2%	-58	-6,0%	-57	-5,8%
Unfälle mit Getöteten	976	-1184	-7,0%	-1161	-6,9%	-1143	-6,8%	-1120	-6,6%	-1095	-6,5%	-1067	-6,3%	-1038	-6,2%	-1008	-6,0%
Unfälle mit Schwerverletzten	16.860																
Unfälle mit Leichtverletzten	111.863	-7512	-6,7%	-7332	-6,6%	-7200	-6,4%	-7043	-6,3%	-6871	-6,1%	-6689	-6,0%	-6505	-5,8%	-6322	-5,7%

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Besitz, Nutzung und Wartung älterer Fahrzeuge

Ergebnisse einer repräsentativen Befragung von Besitzern älterer Pkw

forsa Gesellschaft für
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23. April 2026
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Vorbemerkung

Im Auftrag des TÜV-Verbands e.V. hat forsa Gesellschaft für Sozialforschung und statistische Analysen mbH eine repräsentative Befragung unter Besitzern älterer, mindestens zwölf Jahre alter Fahrzeuge durchgeführt.

Im Rahmen der Untersuchung wurden insgesamt 1.002 nach einem systematischen Zufallsverfahren ausgewählte Besitzerinnen und Besitzer von als Hauptfahrzeug genutzten Pkw, die mindestens zwölf Jahre alt sind, befragt.

Die Befragung wurde vom 15. bis 21. April 2026 im Rahmen des repräsentativen Online-Panels forsa.omninet durchgeführt. Die Untersuchungsbefunde werden im nachfolgenden Ergebnisbericht vorgestellt.

Die ermittelten Ergebnisse können lediglich mit den bei allen Stichprobenerhebungen möglichen Fehlertoleranzen (im vorliegenden Fall +/- 3 Prozentpunkte) auf die Gesamtheit der Besitzer älterer Autos in Deutschland übertragen werden.

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1 Präferierter Fahrzeugtyp beim nächsten Kauf

Eine Mehrheit der Befragten (58 %), die derzeit überwiegend ein älteres Auto fährt, würde beim nächsten Autokauf am ehesten einen Gebrauchtwagen bevorzugen: 38 Prozent würden sich für einen etwa 2 bis unter 6 Jahre alten Gebrauchtwagen entscheiden, 14 Prozent für einen etwa 6 bis unter 12 Jahre alten Gebrauchtwagen und 6 Prozent für ein älteres Modell (12 Jahre oder älter).

Für einen Neuwagen oder einen Jahreswagen würde sich jeweils etwa jeder zehnte Befragte (11 bzw. 13 %) entscheiden.

Die Wahl des nächsten Fahrzeugs hängt auch vom verfügbaren Haushaltsnettoeinkommen ab. So würden sich Befragte mit Einkommen von über 4.000 Euro etwas häufiger für ein „jüngeres“ Fahrzeug entscheiden als die Befragten mit geringeren Einkommen.

Kaufpräferenzen beim nächsten Fahrzeugkauf

Beim nächsten Autokauf würden am ehesten bevorzugen:

	Neuwagen	Jahreswagen	Gebrauchtwagen (zwischen 2 bis unter 6 Jahre alt)	Gebrauchtwagen (zwischen 6 bis unter 12 Jahre alt)	Gebrauchtwagen (12 Jahre oder älter)	es kommt grundsätzlich kein Autokauf (mehr) in Frage
	%	%	%	%	%	%
insgesamt	11	13	38	14	6	9
Männer	13	14	37	14	9	5
Frauen	8	12	39	14	3	12
18- bis 34-Jährige	6	12	48	17	5	1
35- bis 49-Jährige	9	14	38	19	11	1
50- bis 59-Jährige	17	10	35	14	9	2
60 Jahre und älter	11	13	34	11	3	20
Haushaltsnettoeinkommen (in Euro)						
bis unter 2.500	7	8	33	18	9	14
2.500 bis unter 4.000	11	11	38	18	7	9
4.000 und mehr	13	17	42	11	5	6

an 100 Prozent fehlende Angaben = „weiß nicht“ bzw. keine Angabe

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2 Jährliche Fahrleistung des Pkw

Mit dem hauptsächlich genutzten (älteren) Pkw fahren die meisten Befragten jährlich unter 10.000 km: 20 Prozent fahren mit diesem älteren Pkw unter 5.000 km, 36 Prozent fahren damit zwischen 5.000 und 10.000 km.

Bei 24 Prozent der Befragten kommt das Auto auf eine jährliche Fahrleistung von etwa 10.000 bis unter 15.000 km, bei 21 Prozent auf 15.000 km oder mehr.

Die jährliche Fahrleistung ist bei den über 60 Jahre alten Befragten deutlich geringer als bei den jüngeren Befragten. Zudem spielt auch der Wohnort eine Rolle: in Großstädten ist die Fahrleistung tendenziell etwas niedriger als in den eher ländlicheren Regionen.

Jährliche Fahrleistung des Pkw

Mit diesem hauptsächlich genutzten Pkw fahren durchschnittlich pro Jahr

		unter 5.000 km	5.000 bis unter 10.000 km	10.000 bis unter 15.000 km	15.000 bis unter 20.000 km	20.000 km oder mehr
		%	%	%	%	%
insgesamt		20	36	24	11	10
Männer		13	33	27	16	12
Frauen		25	39	21	7	7
18- bis 34-Jährige		10	24	32	17	16
35- bis 49-Jährige		9	38	23	16	14
50- bis 59-Jährige		17	31	30	14	7
60 Jahre und älter		32	44	17	4	4
Erwerbstätigkeit	ja	12	32	27	17	12
	nein	30	42	20	3	5
Ortsgröße (Einwohner):	unter 5.000	11	30	29	16	13
	5.000 bis unter 20.000	18	33	25	14	10
	20.000 bis unter 100.000	23	37	25	6	7
	100.000 bis unter 500.000	20	42	19	10	9
	500.000 und mehr	25	41	19	9	6

an 100 Prozent fehlende Angaben = „weiß nicht“ bzw. keine Angabe

forsa.

3 Gründe für Fahrzeugabgabe

Für etwa ein Viertel der Befragten (27 %) waren bei dem Pkw, den sie zuletzt verkauft oder abgegeben haben, hohe Wartungs-, Reparatur- oder Betriebskosten für die Abgabe des Wagens entscheidend. 22 Prozent hatten den Wunsch nach einem neuen Fahrzeug, z. B. ein moderneres oder verbrauchsärmeres bzw. effizienteres Fahrzeug. Bei 20 Prozent waren festgestellte technische Mängel ausschlaggebend.

Jeweils 11 Prozent geben an, dass sie zuletzt aufgrund eines Unfalls bzw. Schadens oder aufgrund des Bedarfs für ein anderes Fahrzeug (z. B. aufgrund familiärer Veränderungen) einen Pkw abgegeben oder verkauft haben.

Für 8 Prozent war die anstehende Hauptuntersuchung ein ausschlaggebender Grund, den Pkw abzugeben.

13 Prozent der Befragten geben an, noch nie einen Pkw verkauft oder abgegeben zu haben. Dies trifft insbesondere auf die jüngeren Autobesitzer/-innen zu.

Gründe für Fahrzeugabgabe

Ausschlaggebend für den Verkauf oder die Abgabe des letzten Pkw waren folgende Gründe:	insgesamt %	Männer %	Frauen %	18-34 Jahre %	35-49 Jahre %	50-59 Jahre %	60 Jahre und älter %
hohe Wartungs-, Reparatur- oder Betriebskosten	27	28	26	31	26	28	25
Wunsch nach einem neuen Fahrzeug, z. B. ein moderneres oder verbrauchsärmeres/effizienteres Fahrzeug	22	24	21	10	15	22	32
festgestellte technische Mängel	20	24	15	18	18	24	19
Unfall/Schaden	11	12	10	12	14	13	8
Bedarf für anderes Fahrzeug, z. B. aufgrund familiärer Veränderungen	11	10	12	3	19	13	10
die anstehende Hauptuntersuchung (HU)	8	12	5	10	11	13	4
anderer Grund	9	10	8	7	10	10	8
Es haben noch nie einen Pkw verkauft oder abgegeben	13	10	15	38	10	5	3

Prozentsumme größer 100, da Mehrfachnennungen möglich

forsa.

4 Verhalten bei unwirtschaftlichen Reparaturen

Angenommen, an ihrem hauptsächlich genutzter (älteren) Pkw stünden Reparaturen an, deren Kosten voraussichtlich höher wären als der Wert des Fahrzeugs, dann würde etwa ein Drittel das Auto voraussichtlich an einen Händler verkaufen bzw. in Zahlung geben (35 %). Rund ein Viertel (24 %) würde das Auto privat, z. B. über eine Online-Plattform, verkaufen. Ähnlich viele (23 %) würden das Auto trotzdem reparieren lassen.

Kaum jemand gibt an, das Auto in solch einem Fall verschrotten bzw. entsorgen zu lassen.

Ältere Autobesitzer würden etwas häufiger als die jüngeren ihren Pkw in diesem Fall an einen Händler verkaufen bzw. in Zahlung geben, jüngere würden etwas häufiger den Weg des privaten Verkaufs wählen.

Reaktionen auf hohe Reparaturkosten

Angenommen, an ihrem Pkw stünden Reparaturen an, deren Kosten voraussichtlich höher wären als der Wert des Fahrzeugs, dann würden das Auto am ehesten...	insgesamt	Männer	Frauen	18-34 Jahre	35-49 Jahre	50-59 Jahre	60 Jahre und älter
	%	%	%	%	%	%	%
... an einen Händler verkaufen/in Zahlung geben	35	34	36	31	25	31	44
... privat, z. B. über eine Online-Plattform, verkaufen	24	23	25	32	34	26	14
... verschrotten bzw. entsorgen lassen	4	5	3	3	1	3	5
... trotzdem reparieren lassen	23	27	20	15	23	31	25

an 100 Prozent fehlende Angaben = „weiß nicht“ bzw. „etwas anderes“

forsa.

Von denjenigen, die das Auto verkaufen, entsorgen oder als Ersatzteillager nutzen würden, würden die meisten (90 %) sich nach der Abgabe des Autos ein anderes Auto kaufen bzw. leasen. Die Wahl würde dabei bevorzugt (75 %) auf einen Gebrauchtwagen fallen. Nur wenige (15 %) würden sich als „Ersatzfahrzeug“ einen Neuwagen kaufen.

10 Prozent würden das Auto nicht ersetzen.

Gegen einen Ersatz würden sich am ehesten die Großstadtbewohner und die über 60-Jährigen entscheiden.

Wiederbeschaffung eines Fahrzeugs?

Es würden sich nach dem Verkauf bzw. der Abgabe des Autos ein anderes Auto kaufen bzw. leasen

	ja, einen Neuwagen	ja, einen Gebrauchtwagen	nein, es würden das Auto nicht ersetzen
	%	%	%
insgesamt	15	75	10
Männer	18	74	9
Frauen	13	75	11
18- bis 34-Jährige	9	83	8
35- bis 49-Jährige	14	82	4
50- bis 59-Jährige	22	74	5
60 Jahre und älter	16	67	17
Ortsgröße (Einwohner):			
unter 5.000	11	86	3
5.000 bis unter 20.000	13	79	8
20.000 bis unter 100.000	18	75	7
100.000 bis unter 500.000	16	66	18
500.000 und mehr	19	61	19

an 100 Prozent fehlende Angaben = „weiß nicht“ bzw. keine Angabe

forsa.

5 Gründe für Werkstattbesuche

In den letzten 4 Jahren waren rund drei Viertel der Befragten (73 %) mit ihrem älteren Pkw zur Durchführung der Haupt- bzw. Abgasuntersuchung (HU/AU) in einer Kfz-Werkstatt. 60 Prozent haben ihren Wagen zur Inspektion bzw. Wartung in die Kfz-Werkstatt gebracht, 42 Prozent für die Reparatur von Defekten (Instandsetzung) oder wegen (Unfall-)Schäden.

27 Prozent waren zum saisonalen Rad- bzw. Reifenwechsel in einer Kfz-Werkstatt, 21 Prozent zur Vorbereitung auf die HU/AU.

Nur sehr wenige Befragte (4 %) geben an, in den letzten 4 Jahren nicht in einer Kfz-Werkstatt gewesen zu sein.

Gründe für Werkstattbesuche

Es waren in den letzten 4 Jahren aus folgenden Gründen in der Kfz-Werkstatt:

	insgesamt	Männer	Frauen	18-34 Jahre	35-49 Jahre	50-59 Jahre	60 Jahre und älter
	%	%	%	%	%	%	%
Durchführung der Hauptuntersuchung (HU)/ Abgasuntersuchung (AU)	73	69	77	68	80	69	75
Inspektion/Wartung	60	58	63	49	57	63	67
Reparatur von Defekten (Instandsetzung) oder (Unfall-)Schäden	42	42	42	43	47	44	38
saisonaler Rad- bzw. Reifenwechsel	27	22	31	19	27	31	30
Vorbereitung auf die HU/AU	21	19	23	21	26	23	19
andere Gründe	3	3	3	5	3	2	1
Es waren in den letzten 4 Jahren nicht in einer Kfz-Werkstatt.	4	5	2	7	4	4	2

Prozentsumme größer 100, da Mehrfachnennungen möglich