Baseline

Baseline report on the KPI Vehicle Safety

January 2023

Belgium | Austria | Bulgaria | Cyprus | Czech Republic | Finland | Germany | Greece | Ireland | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Poland | Portugal | Spain | Sweden

baseline.vias.be

Project:	This document has been prepared in the framework of the Baseline project, for which a grant has been awarded by the European Commission. Information on this project can be found on the website www.Baseline.vias.be
References:	(1) Grant agreement under the Connecting Europe Facility (CEF) No MOVE/C2/SUB/2019-558/CEF/PSA/SI2.835753 collection of Key Performance Indicators (KPIs) for road safety (2) Consortium agreement among the 18 partners of the Baseline project
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Any comments or feedback regarding this report should be sent to Baseline@vias.be.

Version history

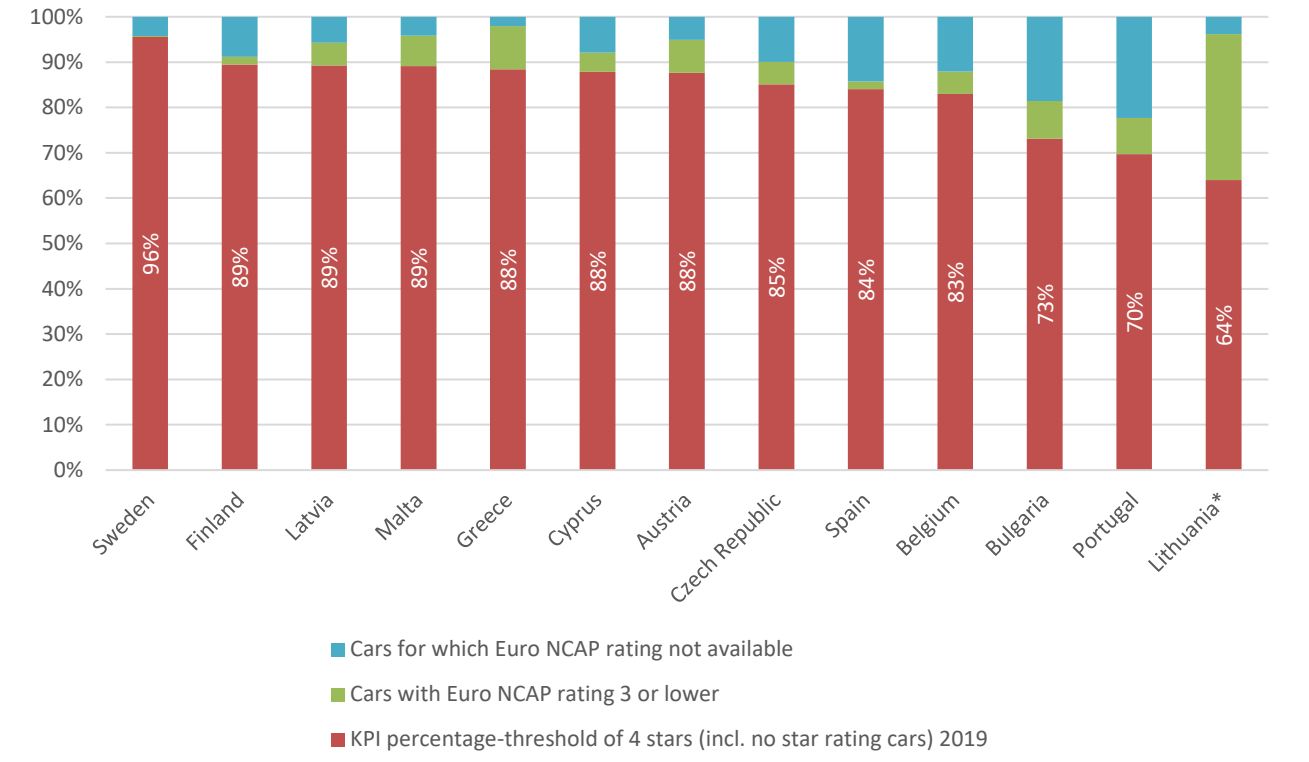
Version	Date	Changes
1.0	April 29, 2022	Pre-draft version (first attempt) of report, using preliminary data of countries that already sent data.
2.0	September 16, 2022	Draft version of report. Countries for which data is available are included in the report.
3.0	October 4, 2022	Draft version of report after feedback from KEG.
4.0	October, 2022	All countries are added to the report. Feedback from KEG and member states is processed.
5.0	December, 2022	All countries that delivered the data are included. All parts of the report are completed.
6.0	January, 2023	Reviews and comments of countries and reviewers are processed. Report is finalized.

Contents

Executive summary

The Baseline KPI on Vehicle Safety is a first attempt to compare European countries in terms of vehicle safety. Thirteen countries delivered the Baseline KPI on Vehicle Safety and they all delivered the standard KPI which is defined as the "Percentage of new passenger cars with a Euro NCAP safety rating equal or above a predefined threshold". These countries are Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Finland, Greece, Latvia, Lithuania, Malta, Portugal, Spain and Sweden.

The figure below shows the main KPI for Vehicle Safety for all countries that delivered this KPI. The main is KPI is the percentage of newly registered passenger cars with a Euro NCAP rating equal or above 4 stars in 2019, cars without a Euro NCAP rating included in the denominator. This number ranges between 96% in Sweden to 64% in Lithuania. For all countries except three, this percentage is above 80%. This means that in most European countries, 80% of the newly registered passenger cars have at least an overall good performance in vehicle safety in 2019.



** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

Looking at the different KPIs that had to be delivered for the Baseline KPI Vehicle Safety, a pattern can be observed. One group of countries (Sweden, Finland and Latvia) has more or less the highest KPI on Vehicle Safety of all countries who delivered data, and another group of countries (Lithuania, Portugal and Bulgaria) has the lowest KPI compared to the other countries. On the country level correlations between the KPI on Vehicle Safety and other indicators such as average age of the vehicle fleet (passenger cars) and fatalities per million inhabitants were found.

The current KPI on Vehicle Safety has shortcomings and could be improved. An issue affecting comparability and the validity of the KPI is that some car manufacturers register cars in one country and export immediately to another country of the European Union for tax reasons. To which extent this influences the KPIs of the different countries is unclear and hard to estimate. A larger shortcoming of the current KPI is that only new passenger cars that are registered in the last year are taken into account. It would be better to develop a Vehicle Safety indicator that covers the whole vehicle fleet. This is however a major challenge for several reasons. A complete Euro NCAP safety rating currently exists only for passenger cars. The Euro NCAP rating system is also evolving continuously, as technology evolves and new innovations become available and thus test protocols advance. Therefore, existing Euro NCAP ratings are only valid for six years. So if the entire vehicle fleet should be covered, a rescaling of the existing Euro NCAP star ratings is needed.

1 Introduction

1.1 Context

The Communication of the European Commission "Europe on the Move – Sustainable Mobility for Europe: safe, connected and clean" of the 13th of May 2018 confirmed the EU's long-term goal of moving close to zero fatalities in road transport by 2050 and added that the same should be achieved for serious injuries. It also proposed new interim targets of reducing the number of road deaths by 50% between 2020 and 2030 as well as reducing the number of serious injuries by 50% in the same period. To measure progress, the most basic – and important – indicators are of course the result indicators on deaths and serious injuries.

In order to gain a better understanding of the different issues that influence overall safety performance, the Commission has elaborated, in cooperation with Member State experts, a first set of key performance indicators (KPIs). The list of the KPIs is given in ***Table 1***. The minimum requirements for these KPIs are described in the *Commission Staff Working Document SWD* (2019a) 283, further referred to as 'SWD'.

Table 1. List of European KPIs for road safety

KPI area	KPI definition
Speed	Percentage of vehicles travelling within the speed limit
Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
Protective equipment	Percentage of riders of PTWs and bicycles wearing a protective helmet
Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
Distraction	Percentage of drivers not using a handheld mobile device
Vehicle Safety	Percentage of passenger cars with a Euro NCAP safety rating equal or above a threshold
Infrastructure	Percentage of distance driven over roads with a rating above an agreed threshold
Post-crash care	Time elapsed between the emergency call following a collision resulting in personal injury and the arrival at the scene of the collision of the emergency services

Funding has been made available by the European Commission to support Member States in the data collection and analysis for these KPIs. Eighteen Member States participate in a common project, called "Baseline". The aim of the BASELINE project, funded partially by the European Commission, is to assist participating Member States' authorities in the collection and harmonized reporting of these KPIs and to contribute to building the capacity of Member States which have not yet collected and calculated the relevant data for the KPIs. The outcomes of this project will be used to set future European targets and goals based on the KPIs.

1.2 Participation in Baseline

The following EU Member States participated in the Baseline project: Austria; Belgium; Bulgaria; Cyprus; Czech Republic; Finland; Germany; Greece; Ireland; Latvia; Lithuania; Luxembourg; Malta; The Netherlands; Poland; Portugal; Spain; Sweden. Some data regarding KPIs of EU Member States that were not participating in Baseline are also included in the deliverables.

1.3 Final deliverables of the Baseline project

The final public outcomes and deliverables of the Baseline project are:

- Eight specific reports, each on one KPI
- A website on which all public information is accessible
- A final report including the key results of the project and recommendations for next steps.

This document is the report providing information on the ***KPI Vehicle Safety***. This KPI has been defined as:

"Percentage of new passenger cars with a Euro NCAP safety rating equal or above a predefined threshold"

"New passenger cars" are interpreted in the following way: cars that are being registered for the very first time (brand new cars), not cars that are second hand and are imported and registered for the first time in the country.

If for certain Member States the Euro NCAP rating is not available for (almost) all vehicles and/or it is not possible to assign a Euro NCAP rating to each vehicle, the Commission accepts two alternative KPIs:

(1) "Average age of the total fleet of car passengers"

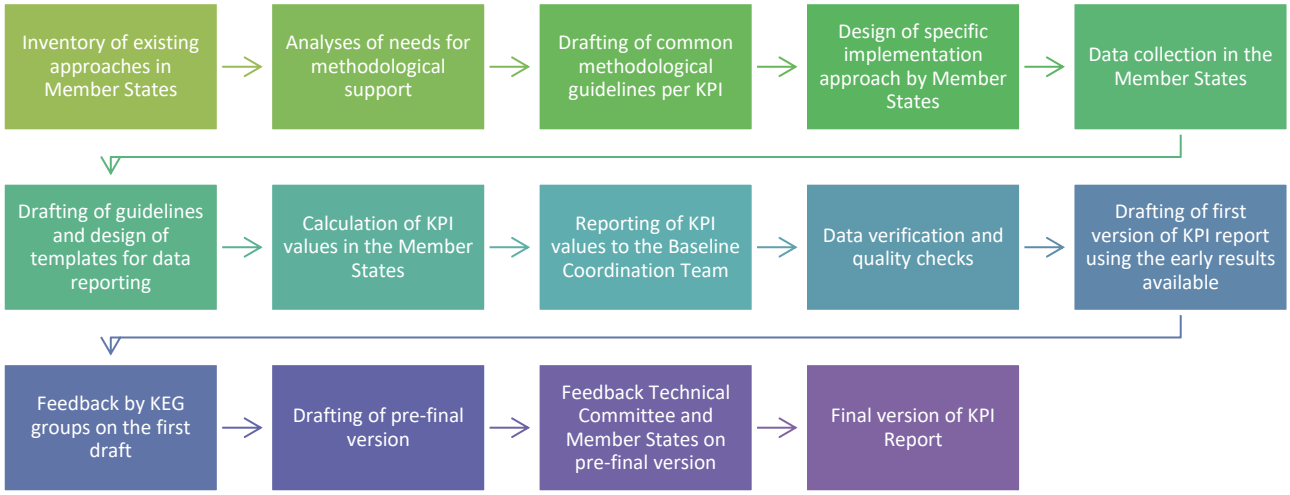
(2) "Percentage of the passenger cars that are roadworthy"

2 Methodology

2.1 Overall process

The process followed for arriving at this report is summarized in the following scheme:

Figure 1. Process leading to this report



For each KPI, a "KPI Expert Group" (KEG) was established, which was responsible for the design of the methodological guidelines and for the review of a draft version of this report. The KEG for the Vehicle Safety indicator consisted of the following persons:

- Jean-François Gaillet, Vias institute (Belgium)
- Wouter Van den Berghe, Vias institute (Belgium)
- Eduard Fernández, CITA
- Adrian Hellman, BASt (Germany)
- Richard Schram, Euro NCAP
- Pete Thomas, Loughborough University (UK)
- Katerina Folla, NTUA (Greece)

The overall process was overseen by the Technical Committee, which focused in particular on issues that were important for several KPIs (e.g. structure and content of methodological guidelines, minimum samples, number of observations and locations, weighting of data, data reporting, etc.). The Technical Committee consisted of:

- Peter Silverans, Vias institute (Belgium) - Coordinator
- Wouter Van den Berghe, Vias institute (Belgium)
- Frits Bijleveld, SWOV (Netherlands)
- Sheila Ferrer López, DGT (Spain)
- Peter Larsson, Trafikverket (Sweden)
- Markus Schumacher, BASt (Germany)
- Veronika Valentova, CDV (Czech Republic)
- George Yannis, NTUA (Greece)

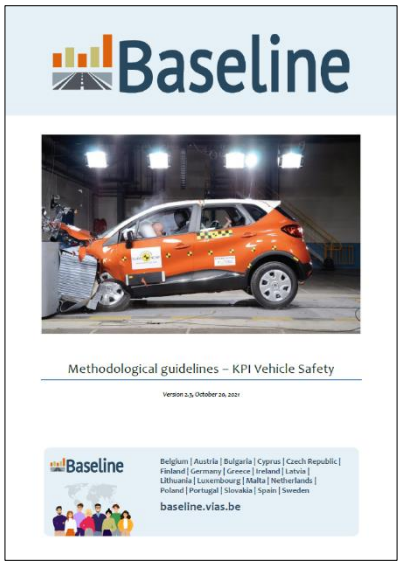
2.2 Support tools developed

For every KPI, methodological guidelines were developed, covering topics such as:

- definition of the KPI concerned, and possibly complementary or alternative KPIs
- methods to be used for data collection
- breakdowns requested of the KPI values (road category, vehicle type, day of week, …)
- minimum sample of observations/cases and observation locations
- methods for weighting and analysing the data
- nature and format of data to be reported

The methodological guidelines of the KPI Vehicle Safety can be accessed from the Baseline website via https://www.baseline.vias.be/storage/minisites/methodological-guidelines-kpi-vehicle-safety-2.3.pdf (Van den Berghe et al., 2021). Many elements of the Methodological Guidelines have been integrated in this report, either within the main body of the text, or as part of the Annex.

In order to streamline and harmonize the data flow, data reporting guidelines and data reporting templates were developed. The data reporting templates (in Excel) were used by the Member States for reporting their KPI values to the Baseline Coordination Team.



BASELINE - Vehicle Safety
Minimum Level (required)

		Standard KPI					
Year	Make & Model	Number of new passenger cars	Number of 1-3-star passenger cars	Number of 4-star passenger cars	Number of 5-star passenger cars	KPI percentage-threshold of 4 stars	KPI percentage-threshold of 5 stars
2019	Total passenger cars (excl. no star rating cars)	465984	30522	21761	413701	93,45%	88,78%
2019	Total passenger cars	498059	30522	21761	413701	87,43%	83,06%
2020	Total passenger cars (excl. no star rating cars)	371847	18667	14576	338604	94,98%	91,06%
2020	Total passenger cars	394910	18667	14576	338604	89,43%	85,74%

2.3 Definition of Vehicle Safety

The active and passive safety performance of vehicles is an essential element of road safety (European Commission, 2019a). Vehicle technology can reduce the likelihood of crashes and mitigate severity of crashes in two ways. Active safety features prevent road crashes, for example Autonomous Emergency Braking and Intelligent Speed Assistance. Secondly, passive safety features protect car occupants during a collision, for example safety belts and airbags.

These active safety features are usually also called ADAS, Advanced Driver Assistance Systems. There is no single definition of ADAS, but in general they refer to systems that support the driver in their primary driving task (European Commission, 2021b). Generally, the most important safety benefits of ADAS are: improved reaction time, improved perception and being less affected by typical human factors such as distraction.

An example of the effect of ADAS on road safety is Autonomous Emergency Braking (AEB). This system detects obstacles in front of the vehicle and activates the braking system attempting to come to a full stop to avoid or reduce the impact of a collision. AEB can reduce rear-end striking crashes with injuries by about 45% (European Commission, 2021b). When combined with Forward Collision Warning (FCW), which warns the driver of obstacles centrally in front the vehicle, rear-end striking crashes are reduced by about 55%. While the effect of vehicle technology and ADAS on road safety is indisputable, there are still challenges (European Commission, 2021b). Technological limitations can affect the accuracy of ADAS, e.g., poor quality of lane markings and bad weather conditions can reduce the effectiveness of ADAS. Also, human-vehicle interaction such as inappropriate trust or insufficient understanding of how the system works can influence the effect of vehicle technology on road safety.

Many types of vehicle technology are or will become mandatory for passenger cars. On the 6th of July 2022 a range of safety systems became mandatory for all new type approvals, including ISA (Intelligent Speed Assist), Lane

Keeping Assist, distraction and fatigue detection and vulnerable road user detection (European Commission, 2019b)[1]. From 7th of July 2024 on these safety systems also become mandatory for all new vehicles with existing type approvals.

Euro NCAP star ratings are a valuable means of assessing car safety (European Commission, 2019a). Euro NCAP, the European New Car Assessment Programme, is a non-profit organization run by transport administrations, research institutes and automobile clubs. Euro NCAP created a five-star safety rating system based on a series of vehicle tests, designed and carried out by the organization (Euro NCAP, 2022a). They perform an extensive, objective and independent assessment of vehicles and make the results available for the public (BASt, 2017). That way, car safety is transparent and comparable for the public in light of purchase decisions. Also, for the automotive industry, Euro NCAP provides the opportunity for an independent assessment of their vehicles, it provides a 'marketplace' for vehicle safety.

The Euro NCAP safety rating is composed of scores in four safety areas: adult occupant protection (for the driver and the passengers), child occupant protection, vulnerable road user protection and safety assist (Euro NCAP, 2022b). Safety assist evaluates driver-assistance and crash-avoidance technologies. The star rating reflects how well the car performs during the tests, and is also influenced by the availability of safety equipment on the tested model in the European market (Euro NCAP, 2022a). Furthermore, the star rating goes beyond legal requirements: a car that just meets the minimum legal requirements is not eligible for any stars. That also means that cars with a low star rating are not necessarily unsafe, but are not as safe as other cars that have a better rating. A 5 star rating can be interpreted as "Overall excellent performance in crash protection and well equipped with comprehensive and robust crash avoidance technology", while a 4 star rating stands for "Overall good performance in crash protection and all round; additional crash avoidance technology may be present" (Euro NCAP, 2020, 2022a).

Moreover, research shows that there is a good correlation between Euro NCAP test results and crash outcomes. Cars with a Euro NCAP rating of 5 stars have about 68% lower risk of fatal injury and about 23% lower risk of serious injury than cars with a 2 star rating (European Commission, 2019a; Kullgren et al., 2010). Other studies found also a positive relation between Euro NCAP star rating and crash outcomes (Kullgren et al., 2019), specifically also for pedestrians (Pastor, 2013; Strandroth et al., 2011).

For the KPI on Vehicle Safety it was decided to assess the safety of the new cars that enter the vehicle fleet of passenger cars in each country in 2019 and 2020. For each country, the percentage of the newly registered passenger cars with a good Euro NCAP star rating (4 stars and more) is calculated. More specifically, KPIs based on two different thresholds are provided; a) a KPI percentage with threshold 4 stars, and b) a KPI percentage with threshold of 5 stars.

2.4 Minimum and optional requirements for the KPI Vehicle safety within Baseline

For the KPI on Vehicle Safety the minimum requirement is to calculate the percentage of newly registered passenger cars with a Euro NCAP safety rating equal or above 4 stars (1) and equal to 5 stars (2). Both KPIs are calculated in two ways, once including cars without a star rating in the denominator, and once excluding cars without a star rating in the denominator. By definition, the KPI including cars without star rating is lower than the KPI excluding cars without star rating. Both KPIs (threshold 4 stars and 5 stars) are calculated for the years 2019 and 2020. These are filled in the aggregate datafile. It is also required to provide some metadata related to this KPI, such as the source of the data that was used for the calculation and whether the data covers to whole country.

Optionally, countries can provide the semi-aggregate datafile for the KPI on Vehicle Safety. This file contains a list of all car models for which a Euro NCAP rating is available and the exact number of each model newly registered in the country for 2019 and 2020.

[1] Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users.

3 Results

3.1 Overall results

Thirteen countries delivered the Baseline KPI on Vehicle Safety and they all delivered the standard KPI which is defined as the "Percentage of new passenger cars with a Euro NCAP safety rating equal or above a predefined threshold". Consequently, the alternative indicators for this KPI were not used and discussed.

3.1.1 Metadata

Table 2 presents the Member States that delivered the KPI for Vehicle Safety. Metadata on the KPI Vehicle Safety is also presented.

Table 2. Member States delivering the KPI Vehicle Safety and metadata

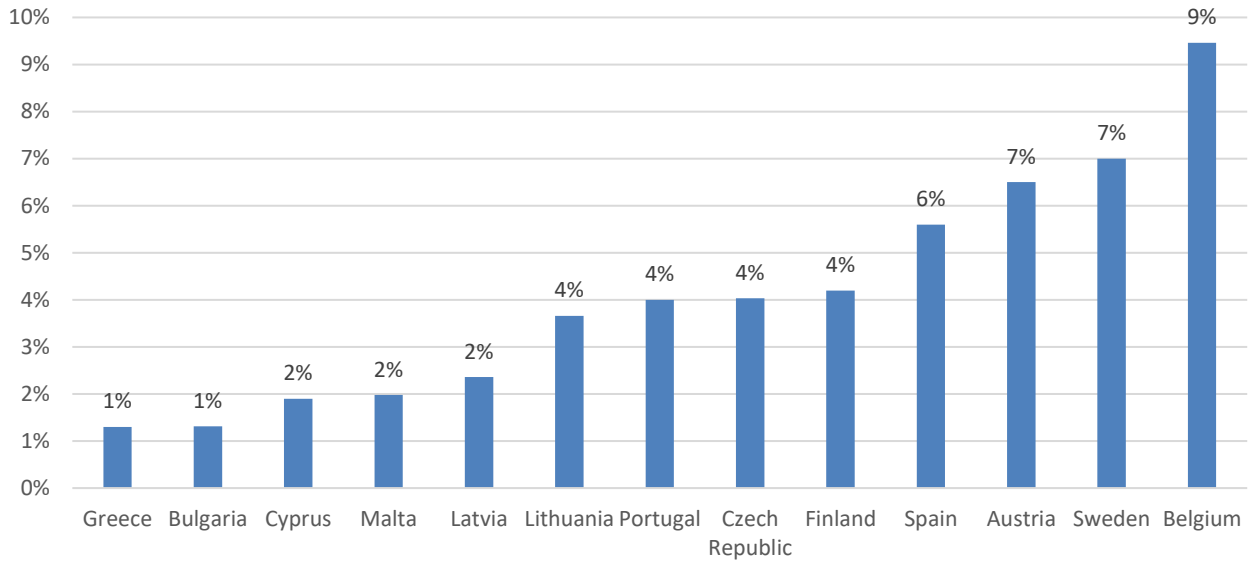
	Source of car registration data	Percentage of newly registered passenger cars for which no Euro NCAP rating available 2019	Percentage of new vehicles in relation to the entire vehicle fleet per year 2019[a]
Austria	Statistics Austria	5.1%	6.5%
Belgium	Febiac, the federation of the automobile and motorcycle industries in Belgium and Luxembourg	12.1%	9.5%
Bulgaria	Official Traffic Police registration records database	18.5%	1.3%
Cyprus	Cypriot Ministry of Transport, Communications and Works	7.9%	1.9%
Czech Republic	Ministry of Transport of the Czech Republic	10.0%	4.0%
Finland	Finnish Transport and Communications Agency Traficom's Transport Register	8.8%	4.2%
Greece	Hellenic Ministry of Infrastructure and Transport	2.1%	1.3%
Latvia	Latvian road vehicle register	5.7%	2.4%
Lithuania	State Enterprise "Regitra"	3.8%	3.7%
Malta	Authority for Transport in Malta official car registration database	1.6%	2.0%
Portugal	Instituto da Mobilidade e dos Transportes, I.P.	22.3%	4%
Spain	Vehicle registration DB (DGT)	14.2%	5.6%
Sweden	Official car sales figures, Mobility Sweden	4.3%	7%

[a] It is not sure whether "Percentage of new vehicles in relation to the entire vehicle fleet per year" is 100% comparable, as it is possible that some countries have included only passenger cars in the percentage, and others all types of vehicles (in numerator as well as denominator).

Figure 2 presents the percentage of new vehicles in relation to the entire vehicle fleet for 2019 for all the countries who delivered the KPI Vehicle Safety. It is part of the metadata that had to be delivered with the KPI. The explanation of the figure that had to be delivered was however not so clear, therefore there are doubts about the comparability of these numbers between the countries. It was not stipulated whether it concerned only passenger cars or all types

of vehicles, therefore it is possible that some countries only gave the number for passenger cars, or for all types of vehicles, in the numerator as well as in the denominator.

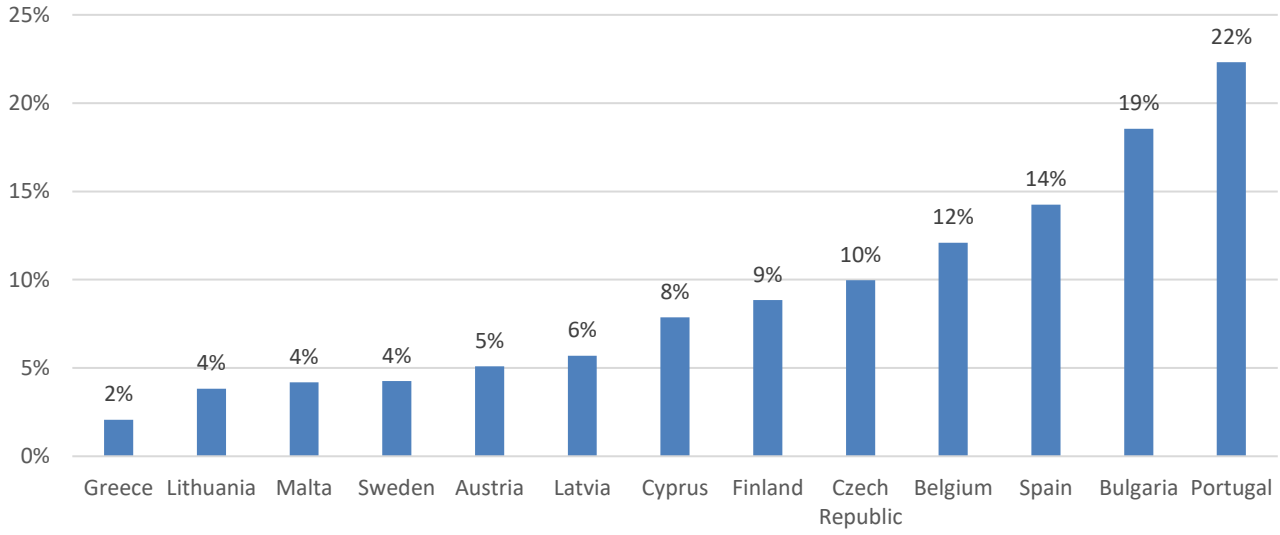
Figure 2. Percentage of new vehicles in relation to the entire vehicle fleet 2019 for all participating countries



It is not sure whether the numbers in this graph are 100% comparable, as it is possible that some countries have included only passenger cars, and others all types of vehicles (in numerator as well as denominator).

Figure 3 shows the percentage of newly registered passenger cars for which no Euro NCAP rating was available for 2019 for all countries. This info was part of the metadata, but for comparability reasons it was calculated from the data itself that the countries delivered. This number has a large variation and ranges between 2% in Greece to 22% in Portugal. These differences can be explained by differences between countries in vehicle fleet of passenger cars, but possibly also differences in the process of linking the registration data with the Euro NCAP data.

Figure 3. Percentage of newly registered passenger cars for which no Euro NCAP rating available 2019 for all participating countries



3.1.2 National KPIs on Vehicle Safety

Table 3 shows the national KPI indicators on Vehicle Safety, including passenger cars without star rating for all countries for 2019 and 2020. This means that, for this KPI, newly registered passenger cars for which no Euro NCAP rating was available, are included in the denominator. The KPI percentage-threshold of 4 stars means that, for example in Austria, 87.6% of the newly registered passenger cars in 2019 had a Euro NCAP star rating of 4 or higher.

Table 3. National KPI indicators Vehicle Safety, threshold of 4 and 5 stars (including no star rating cars) 2019 and 2020

	2019		2020	
	KPI percentage-threshold of 4 stars (incl. no star rating cars)	KPI percentage-threshold of 5 stars (incl. no star rating cars)	KPI percentage-threshold of 4 stars (incl. no star rating cars)	KPI percentage-threshold of 5 stars (incl. no star rating cars)5
Austria	87.6%	71.4%	88.7%	74.3%
Belgium	83.0%	69.0%	89.1%	74.8%
Bulgaria	73.1%	55.6%	64.9%	56.4%
Cyprus	87.9%	81.1%	86.9%	82.5%
Czech Republic	85.1%	75.8%	92.3%	83.1%
Finland	89.5%	82.6%	90.4%	85.2%
Greece	88.4%	60.0%	89.2%	67.5%
Latvia	89.3%	81.2%	92.4%	85.2%
Lithuania*	64.0%	48.3%	57.0%	43.2%
Malta	89.2%	55.2%	89.1%	67.0%
Portugal	69.7%	53.9%	79.4%	65.7%
Spain	84.0%	67.9%	81.8%	68.8%
Sweden	95.5%	93.1%	94.7%	93.0%

* The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.

The KPI of Lithuania is low compared to the other countries and is also the lowest of all countries. The reason is that car manufacturers use Lithuania's lower taxes to register vehicles and re-export them immediately to other European Union markets as used models with 0 km. So, eventually these cars never drive on Lithuanian roads. For instance, as Fiat does this on a large scale in Lithuania, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Based on the information provided by the Lithuanian Baseline partner for this KPI, in 2019 26% of the newly registered passenger cars were Fiat 500's, and 95% of those were de-registered within the first year. In 2020 also 26% of the newly registered passenger cars in Lithuania were a Fiat 500, of which 92% were de-registered within the first year. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries, but it is possible that the KPI of other countries is also influenced by this phenomenon. For example, the cars registered in Lithuania and immediately re-exported are not included in the KPI of the country to which the cars are exported, even though they are new with 0 km.

Table 4 shows the national KPI indicators Vehicle Safety excluding cars without star rating for all countries for 2019 and 2020. This means that, for this KPI, newly registered passenger cars for which no Euro NCAP rating was available, are not included in the denominator. The KPI percentage-threshold of 4 stars means that, for example in Austria,

92.3% of the newly registered passenger cars in 2019 had a Euro NCAP star rating of 4 or higher, excluding cars for which no Euro NCAP rating is available in the denominator.

Table 4. National KPI indicators Vehicle Safety, threshold of 4 and 5 stars (excluding no star rating cars) 2019 and 2020

	2019		2020	
	KPI percentage-threshold of 4 stars (excl. no star rating cars)	KPI percentage-threshold of 5 stars (excl. no star rating cars)	KPI percentage-threshold of 4 stars (excl. no star rating cars)	KPI percentage-threshold of 5 stars (excl. no star rating cars)
Austria	92.3%	75.2%	93.0%	77.9%
Belgium	94.4%	78.5%	95.2%	80.0%
Bulgaria	89.8%	68.2%	90.4%	78.6%
Cyprus	95.4%	88.1%	93.6%	88.9%
Czech Republic	94.5%	84.2%	96.1%	86.5%
Finland	98.1%	90.7%	97.9%	92.2%
Greece	90.3%	61.3%	92.4%	69.9%
Latvia	94.7%	86.1%	96.9%	89.3%
Lithuania*	66.5%	50.2%	58.8%	44.6%
Malta	93.1%	57.6%	90.7%	68.2%
Portugal	89.7%	69.4%	92.7%	76.7%
Spain	98.0%	79.2%	98.8%	83.1%
Sweden	99.8%	97.3%	99.8%	98.0%

***** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.

In the Figures that follow, ***Figure 4*** till ***Figure 8***, countries are ordered from the highest to the lowest value of the KPI percentage-threshold of 4 stars, as this KPI is chosen as the main KPI (see further).

Figure 4 shows the KPI percentage-threshold of 4 and 5 stars for all countries, including cars without star rating in the denominator for 2019.

Figure 4. KPI Vehicle Safety for all Member States for 2019, including cars without Euro NCAP star rating

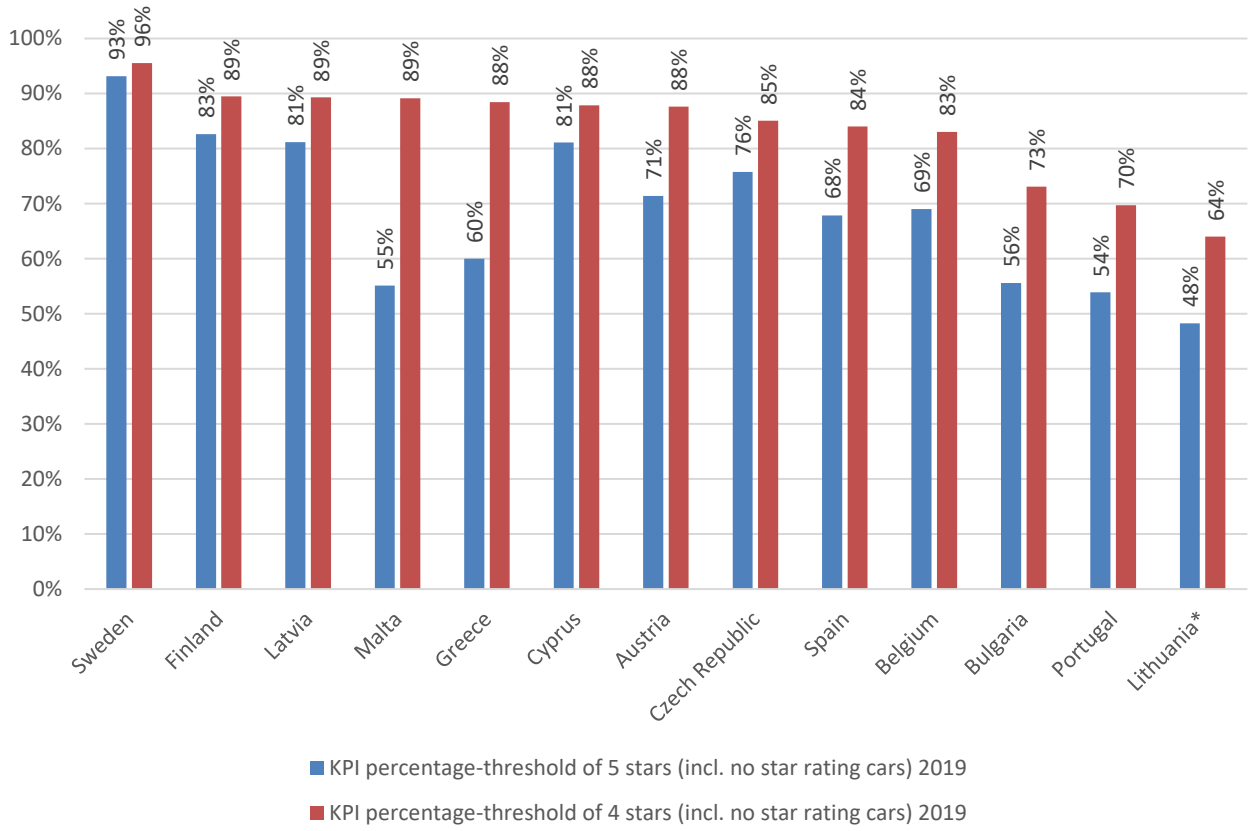


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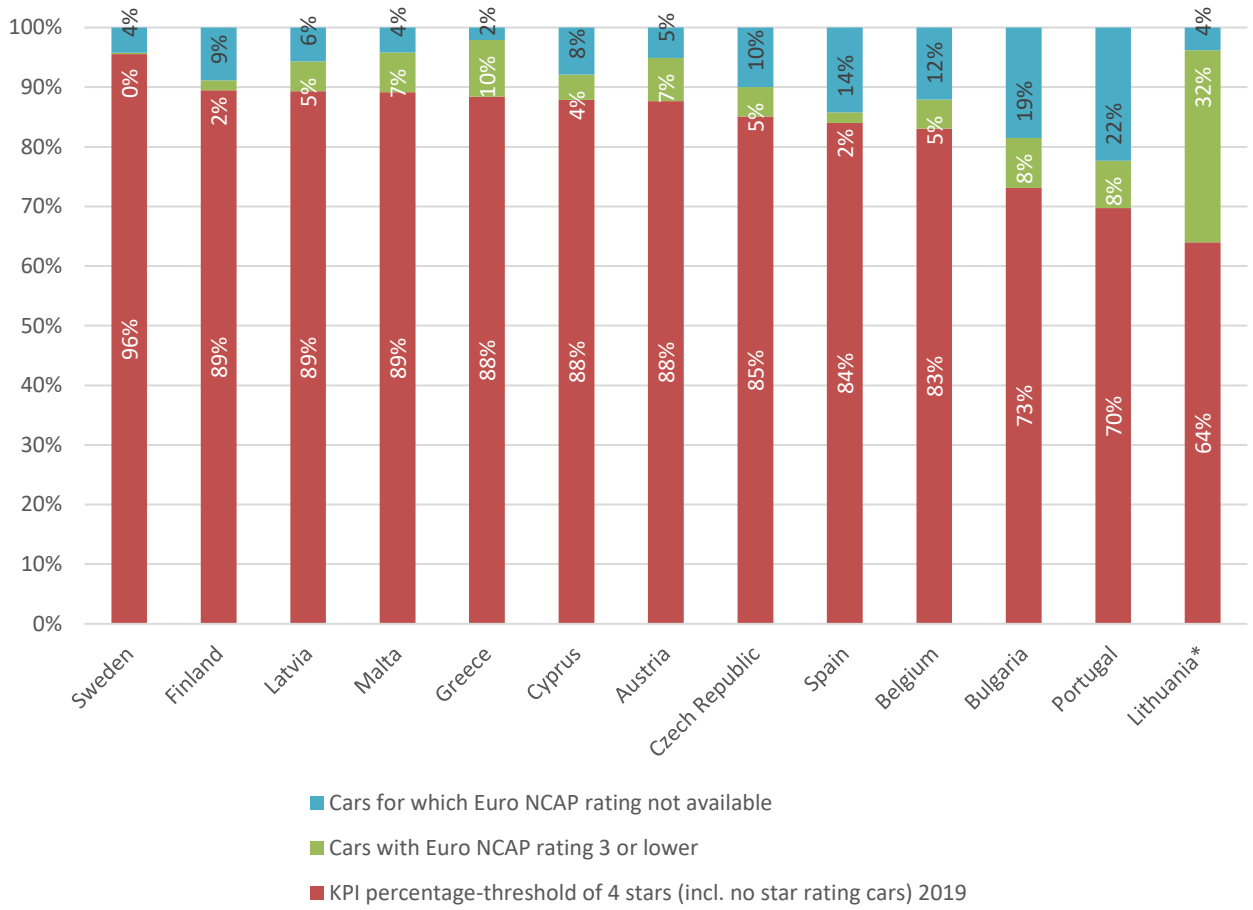
Figure 5 shows the main KPI on Vehicle Safety, namely the percentage of newly registered passenger cars with a Euro NCAP star rating of 4 or higher for 2019, including cars without star rating in the denominator. In the figure, this percentage is combined with the percentage of newly registered passenger cars with a Euro NCAP rating of 3 stars or less, and the percentage of newly registered passenger cars for which no Euro NCAP star rating is available. These numbers add up to 100%: the total of newly registered passenger cars in 2019 in each country. This KPI was chosen as the main KPI for the following reasons:

- The KPI of the year 2019 is chosen instead of 2020, as 2019 is a 'normal' year compared to 2020, which was influenced to a large extent by the covid pandemic. It should also be mentioned that for all countries, fewer cars were registered in 2020 than in 2019.
- The threshold of 4 stars was chosen instead of 5 stars, as 4 stars stands for good overall performance in Vehicle Safety and is thus more suitable for comparing countries. Also, for all countries the large majority of newly registered passenger cars has at least 4 stars.
- Lastly, the KPI including cars without star rating in denominator was chosen as it gives a better picture of the new passenger cars coming into the vehicle fleet in a specific year for a specific country. If the proportions of the newly registered passenger cars for which no Euro NCAP star rating is available differ a lot between countries, this could affect comparability. This can be illustrated by the following (extreme) example: suppose there exists a country where only a small proportion of the newly registered passenger

cars is tested by Euro NCAP, e.g. 15%. Suppose also that 100% of the newly registered cars in that country that were tested by Euro NCAP have a rating of 4. In this example the country would have a KPI of 100% excluding cars without Euro NCAP rating (in denominator) and a KPI of 15% including cars without star rating. The KPI excluding cars without Euro NCAP rating would miss the important aspect that it was 100% of a small proportion of newly registered passenger cars.

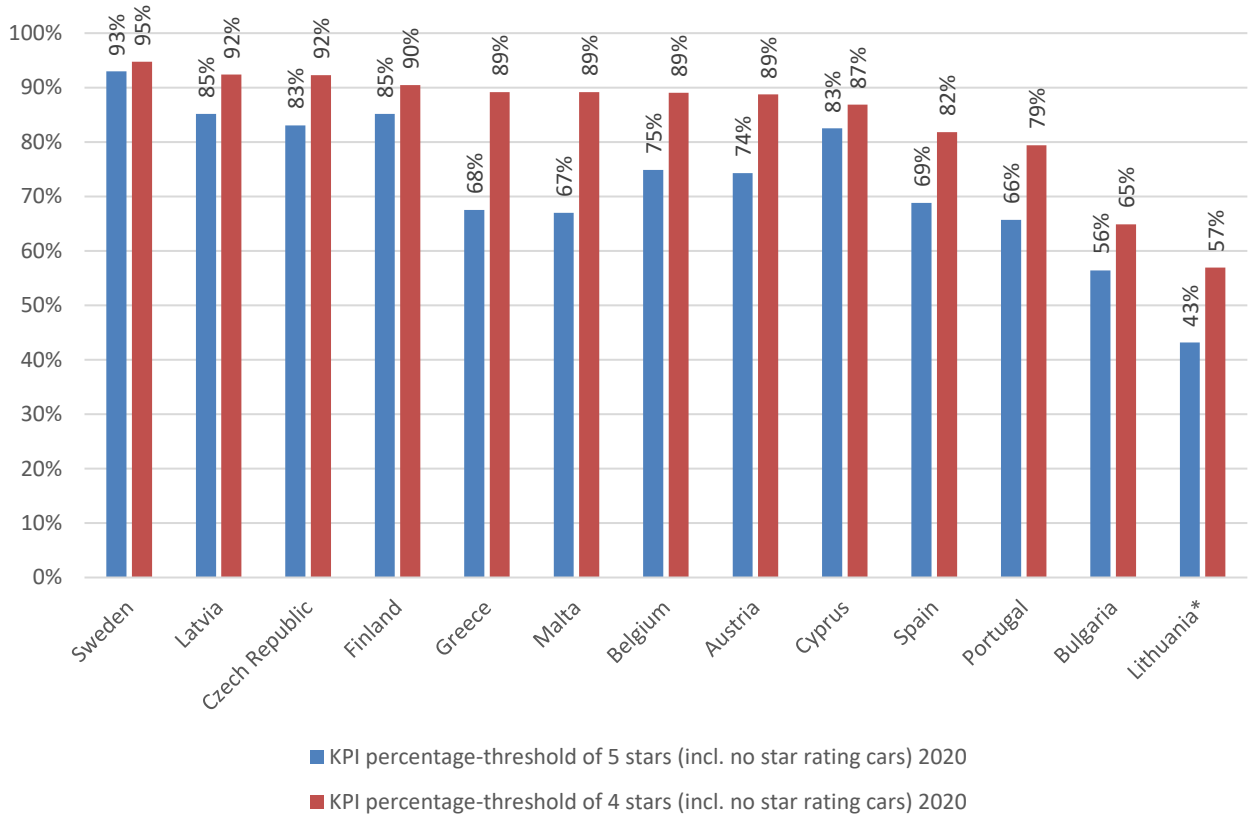
Figure 5. KPI percentage-threshold of 4 stars (including no star rating cars) 2019, combined with percentage of cars with Euro NCAP star rating 3 or lower and percentage of cars for which no Euro NCAP rating is available



** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

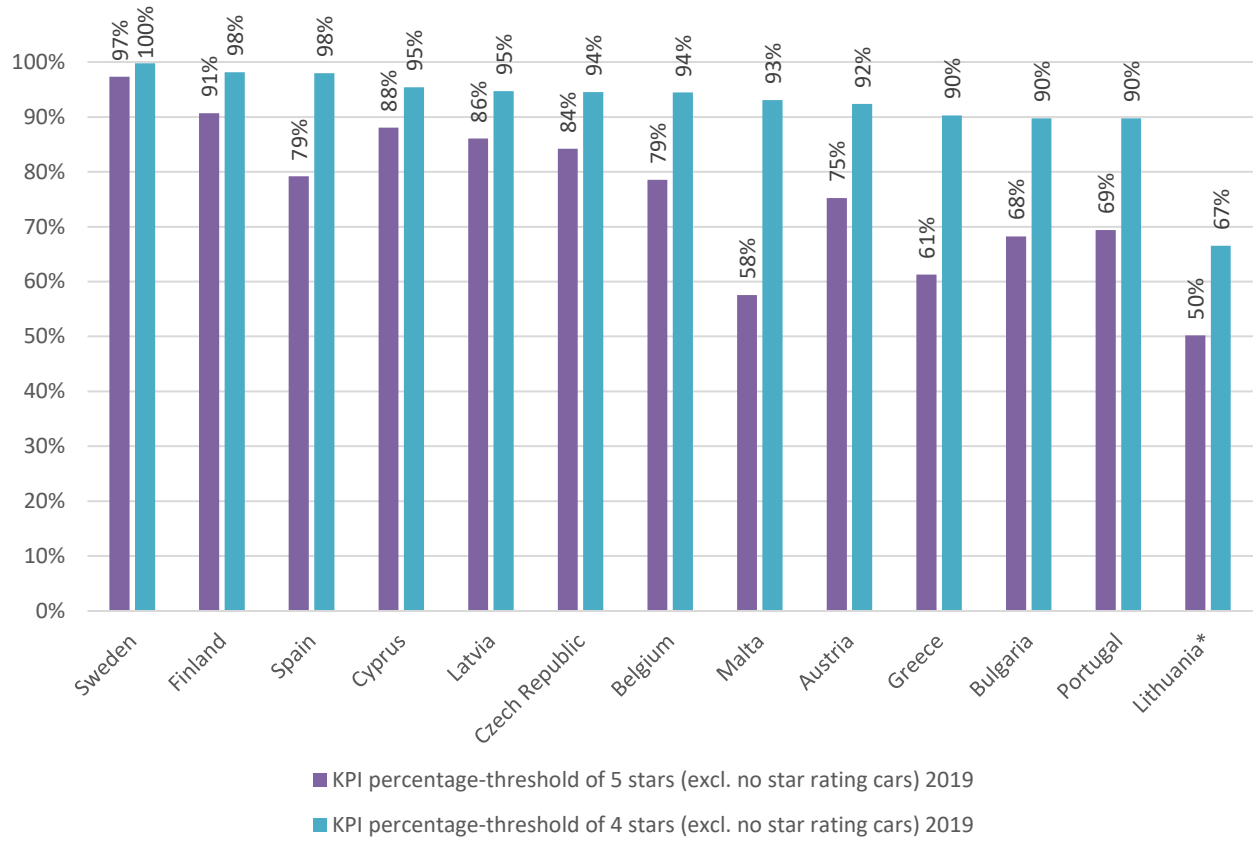
The percentage of newly registered passenger cars with Euro NCAP star rating 4 or higher for 2019 (including cars without star rating in the denominator) ranges between 96% for Sweden to 64% in Lithuania. For all countries except three, this percentage is above 80%. This means that in most European countries, 80% of the newly registered passenger cars have at least an overall good performance in vehicle safety in 2019.

Figure 6. KPI Vehicle Safety for all Member States for 2020, including cars without Euro NCAP star rating



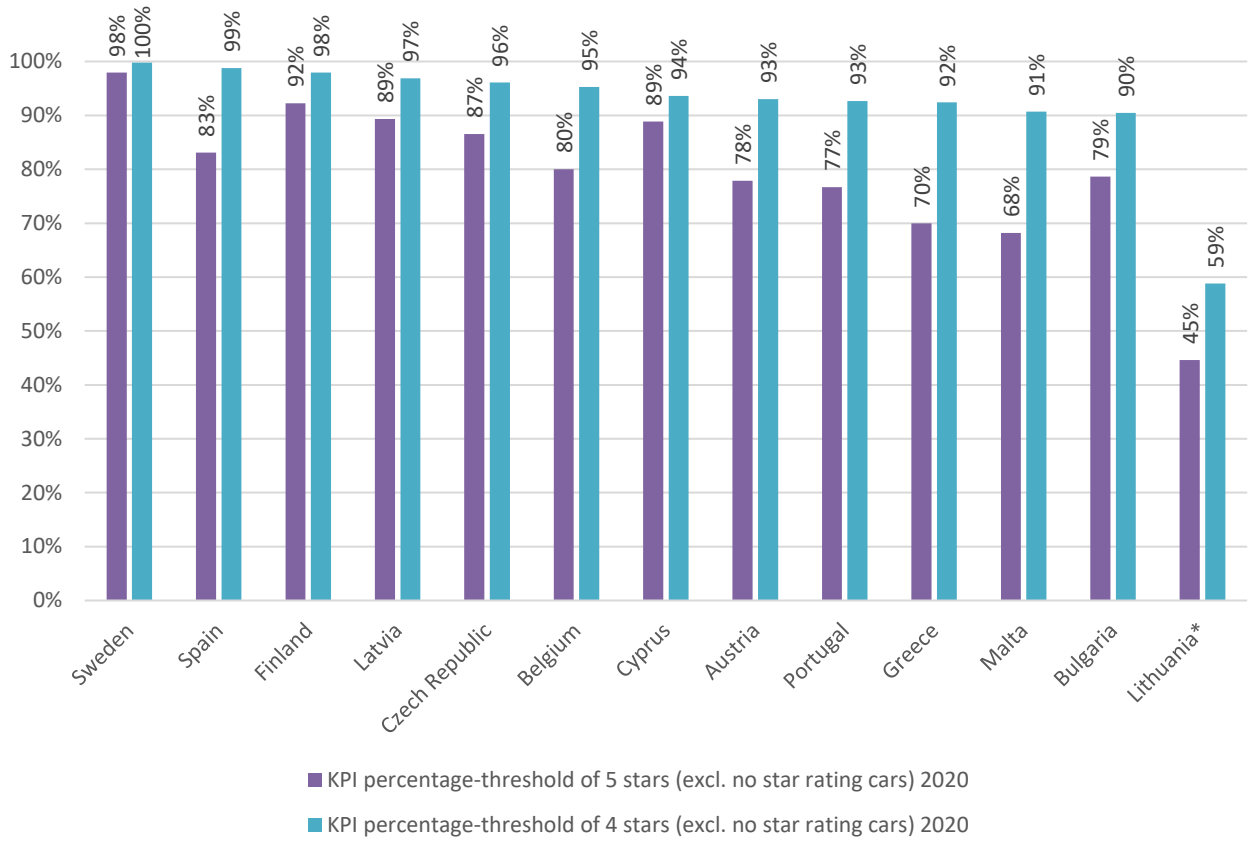
** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

Figure 7. KPI Vehicle Safety for all Member States for 2019, excluding cars without Euro NCAP star rating



** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

Figure 8. KPI Vehicle Safety for all Member States for 2020, excluding cars without Euro NCAP star rating

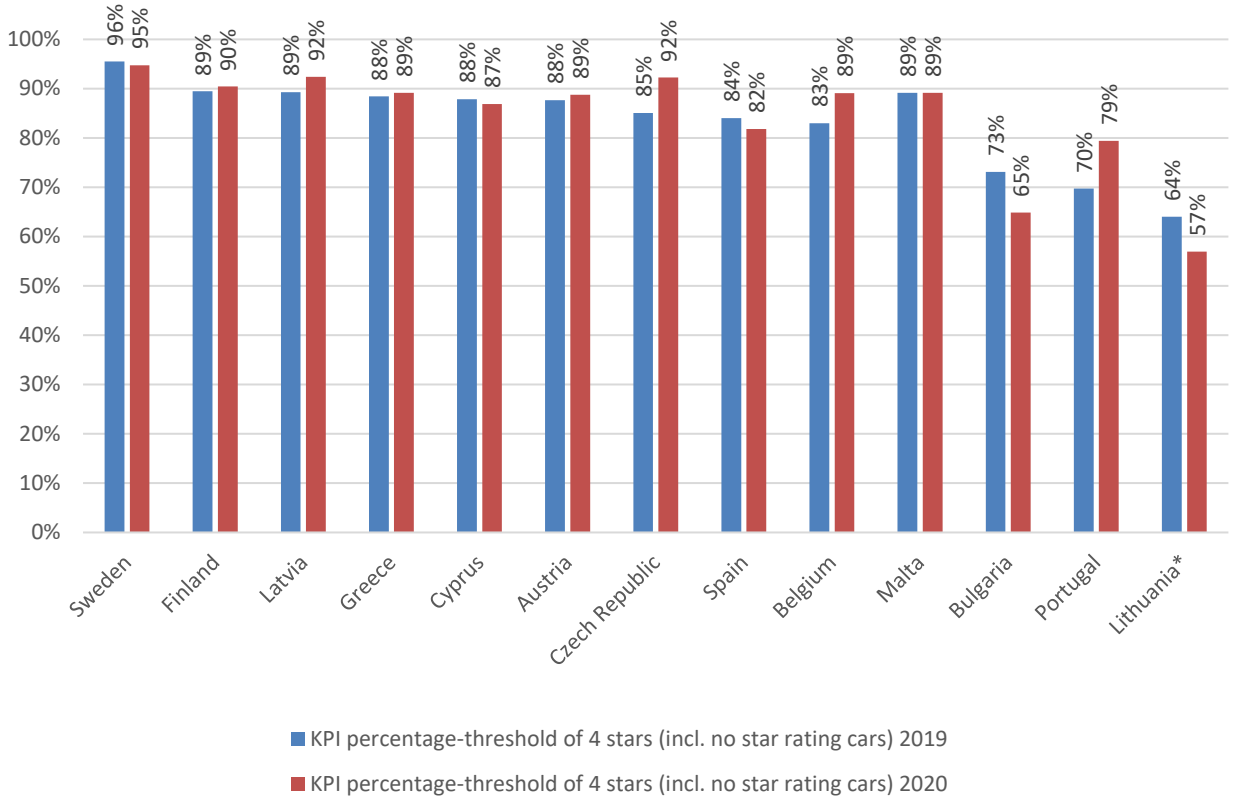


** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

Considering ***Figure 4*** till ***Figure 8*** it can be observed that the ranking of the countries for the different KPIs is not always the same. Taking into account the ranking determined by the KPI percentage-threshold of 4 stars, it can be observed that the countries Sweden, Finland and Latvia have more or less the highest KPI of all countries who delivered this KPI. Another group of countries have the lowest KPI compared to the other countries: Lithuania, Portugal and Bulgaria. So, the pattern over the five graphs is that one group of countries has the highest KPI and another group of countries have the lowest KPI.

Figure 9 compares the KPI Vehicle Safety with threshold 4 stars (including cars without star rating in denominator) for 2019 and 2020.

Figure 9. KPI Vehicle Safety with threshold 4 stars for all Member States for 2019 and 2020, including cars without Euro NCAP star rating



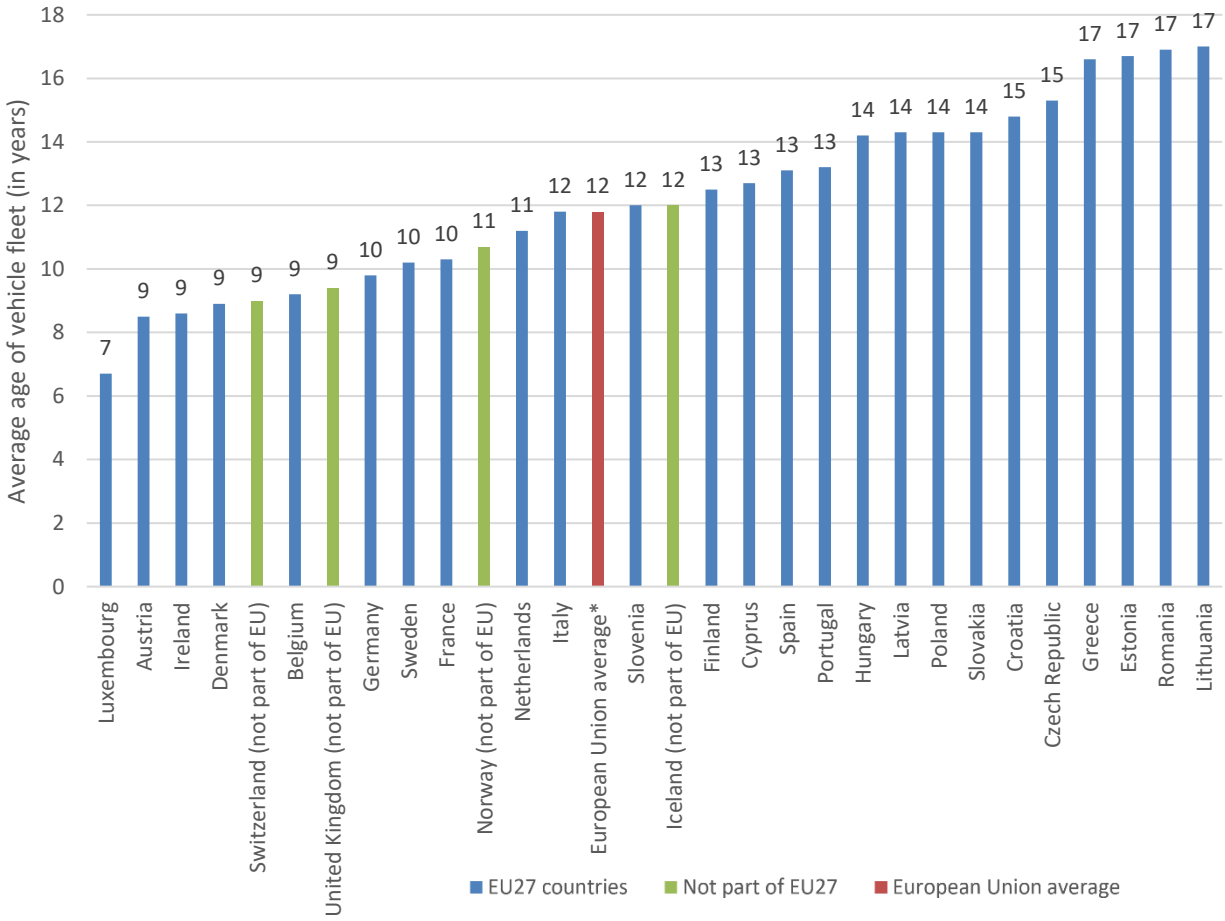
** The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

For all countries it can be observed that both KPIs of 2019 and 2020 are very similar. For almost all countries the KPI for 2020 improved compared to 2019, except for Sweden, Cyprus, Spain, Bulgaria, Lithuania and Malta. For Bulgaria the KPI for 2020 decreased the most compared to 2019, a decrease of 8 percentage points. In Portugal and Czech Republic, the KPI increased the most between 2019 and 2020, with respectively 10 and 7 percentage points.

3.2 Additional indicators

An alternative indicator for the KPI Vehicle Safety is the average age of the vehicle fleet of passenger cars, which is shown in ***Figure 10*** (source: ACEA, 2022, for Cyprus: NTUA (Greece)). ACEA did not include Cyprus in their report, but the Baseline partner for Cyprus included the average age of the vehicle fleet in the semi-aggregate datafile they delivered for the KPI Vehicle Safety.

Figure 10. Average age of the vehicle fleet (in years) of passenger cars for all European countries in 2020

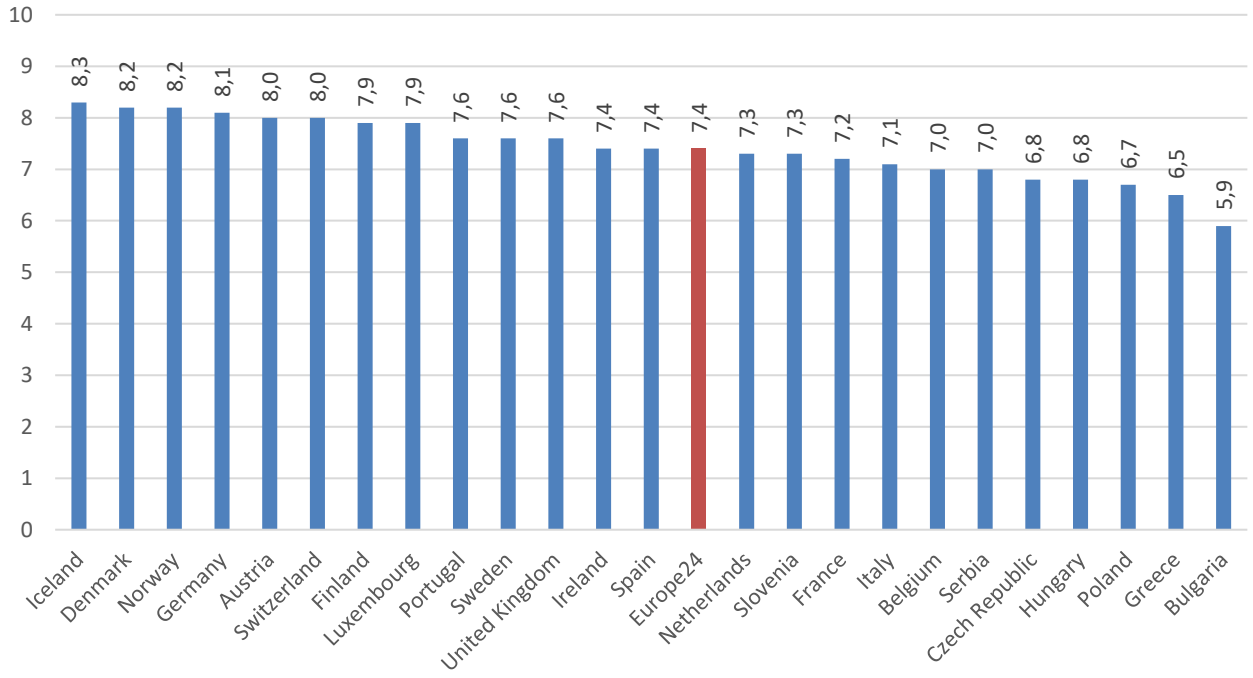


***** *The European Union average does not include Cyprus as the figure of Cyprus comes from another source.*
Source: ACEA (2022), for Cyprus: NTUA (Greece).

The average age of the vehicle fleet of the European Union in 2020 is 12 years. Luxembourg is the country with the youngest vehicle fleet (on average 7 years old). Luxembourg is followed by a group of countries where the passenger car fleet is on average 9 years old: Austria, Ireland, Denmark, Switzerland, Belgium and the United Kingdom. In Greece, Estonia, Romania and Lithuania the average age of the passenger car fleet is the oldest (17 years).

International comparable data on subjective safety feeling of car drivers and car passenger exists, and one could formulate the hypothesis that subjective safety feeling might correlate with the safety level of the vehicle park. Subjective safety feeling of car drivers and car passenger is measured in ESRA2, the international E-Survey on Road users' Attitudes (Meesmann et al., 2022). Car drivers and car passengers in different countries were asked "How safe or unsafe do you feel when using the following transport modes in [country]?". The results for the European countries are shown in ***Figure 11*** and ***Figure 12***.

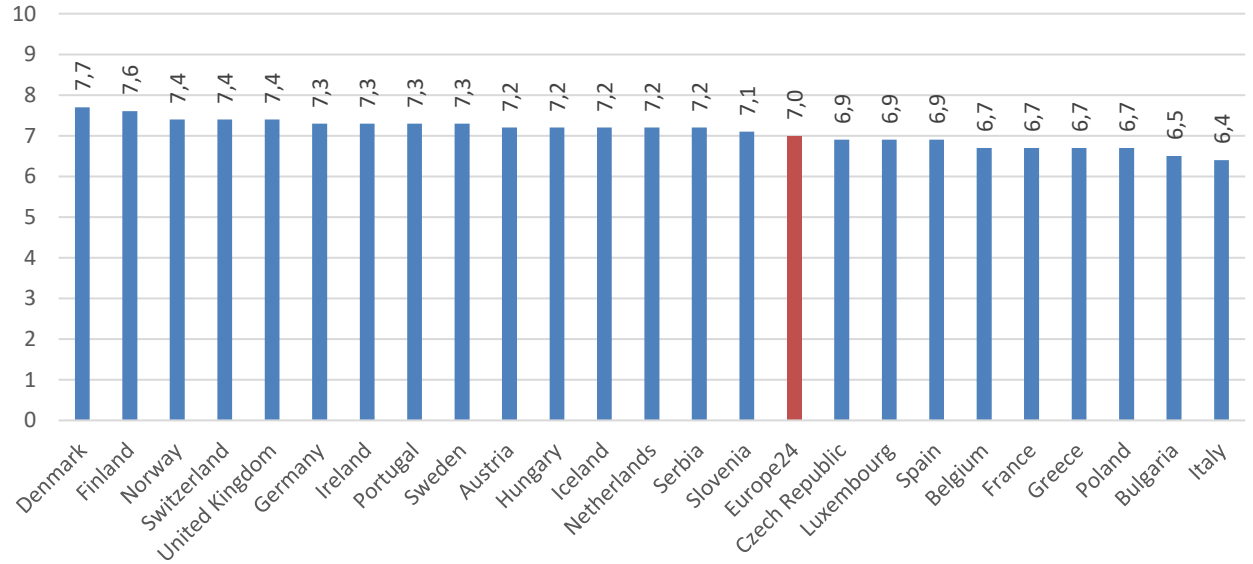
Figure 11. Safety feeling for car drivers, by country and region



Reference population: all road users who used this specific transport type in the past 12 months. Mean score of a 11-point scale, where 0 = very unsafe & 10 = very safe.
Source: ESRA2 (2022).

Car drivers feel the safest in Iceland, Denmark and Norway, with 8.2-8.3 on the scale of 0 to 10. However, the differences with the countries that follow in the ranking are small. On average European car drivers rate the safety feeling for driving a car on 7.4. In Poland, Greece and Bulgaria, car drivers feel the most unsafe of all European countries (included in ESRA), with a score of 5.9 to 6.7 on a scale from 0 to 10.

Figure 12. Safety feeling for car passengers, by country and region



Reference population: all road users who used this specific transport type in the past 12 months. Mean score of a 11-point scale, where 0 = very unsafe & 10 = very safe.
Source: ESRA2 (2022).

Car passengers feel the safest in Denmark, Finland, Norway, Switzerland and the United Kingdom with a score of 7.4-7.7 on a scale from 0 to 10. Again, the difference with the countries that follow in the ranking is small. The European average is at 7. The countries where car passengers feel most unsafe are Bulgaria and Italy, with scores 6.4-6.5 on a scale from 0 to 10.

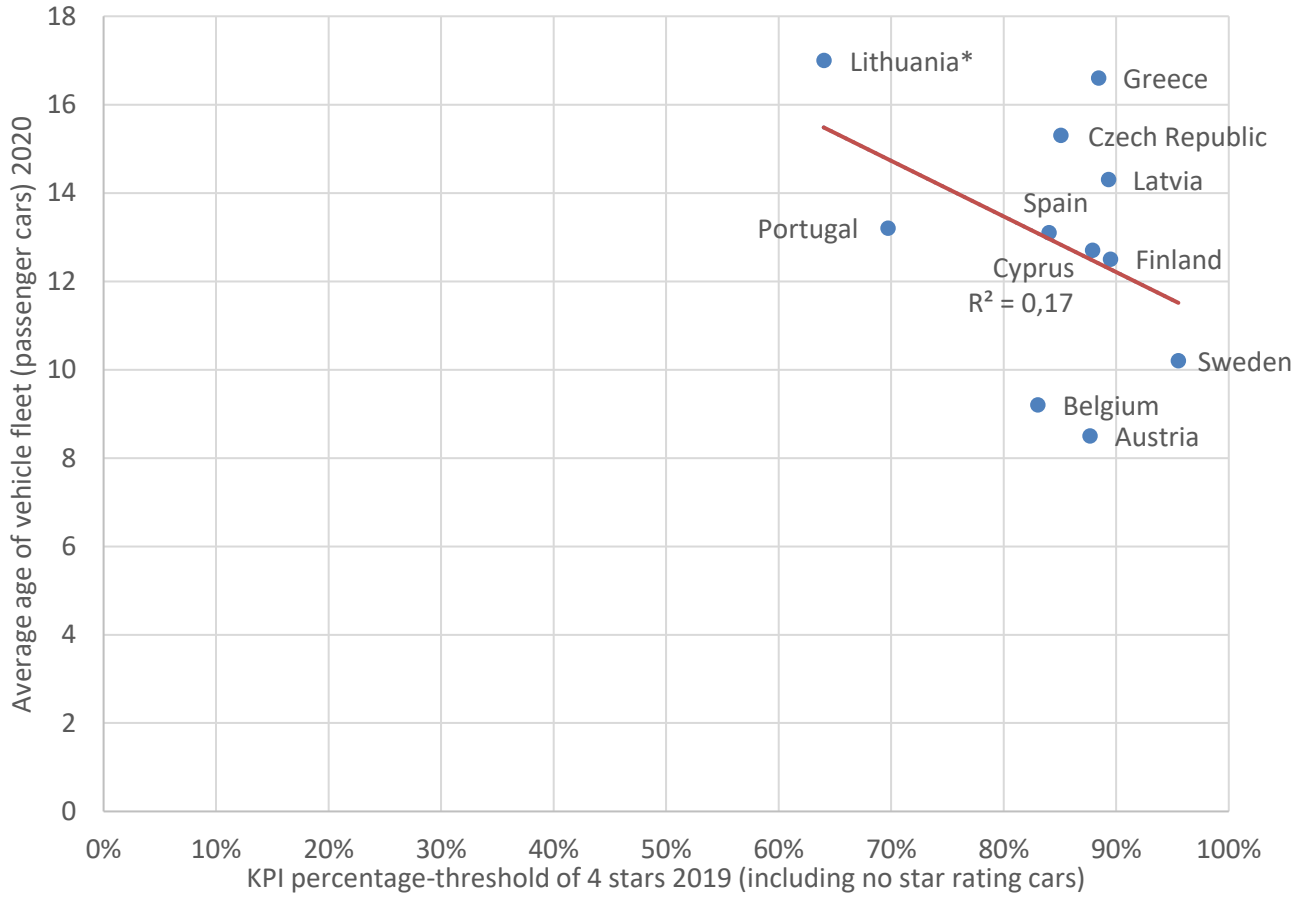
3.3 Supplementary analyses

In the next section some correlations are calculated between the KPI on Vehicle Safety and other indicators. When a correlation can be found, it means that there is a positive or negative association between the two indicators, but this does not mean there is also a causal relationship between them. The association is usually the result of another indicator being the cause of the two indicators. The strength of the correlations is interpreted according to Cohen (1988): a correlation of 0.1 is considered as a weak association, a moderate association starts at a correlation of 0.3 and a correlation larger than 0.5 is considered as a strong association. Furthermore, one should be cautious when interpreting correlations on country level, as it does not say anything about individual correlations and the individual correlation could even be the opposite (cf. ecological fallacy).

3.3.1 Relation between KPI percentage-threshold of 4 stars (including no star rating cars) 2019 and average age of vehicle fleet (passenger cars)

Figure 13 shows the relation between KPI percentage-threshold of 4 stars in 2019 (including no star rating cars) and average age of vehicle fleet in 2020 (passenger cars) (ACEA, 2022; for Cyprus: NTUA)) for all countries for which both figures were available (11 countries).

Figure 13: Scatterplot KPI percentage-threshold of 4 stars 2019 (including no star rating cars) and average age of vehicle fleet (passenger cars) 2020



Source average age of vehicle fleet for passenger cars: ACEA (2022), for Cyprus: NTUA (Greece).

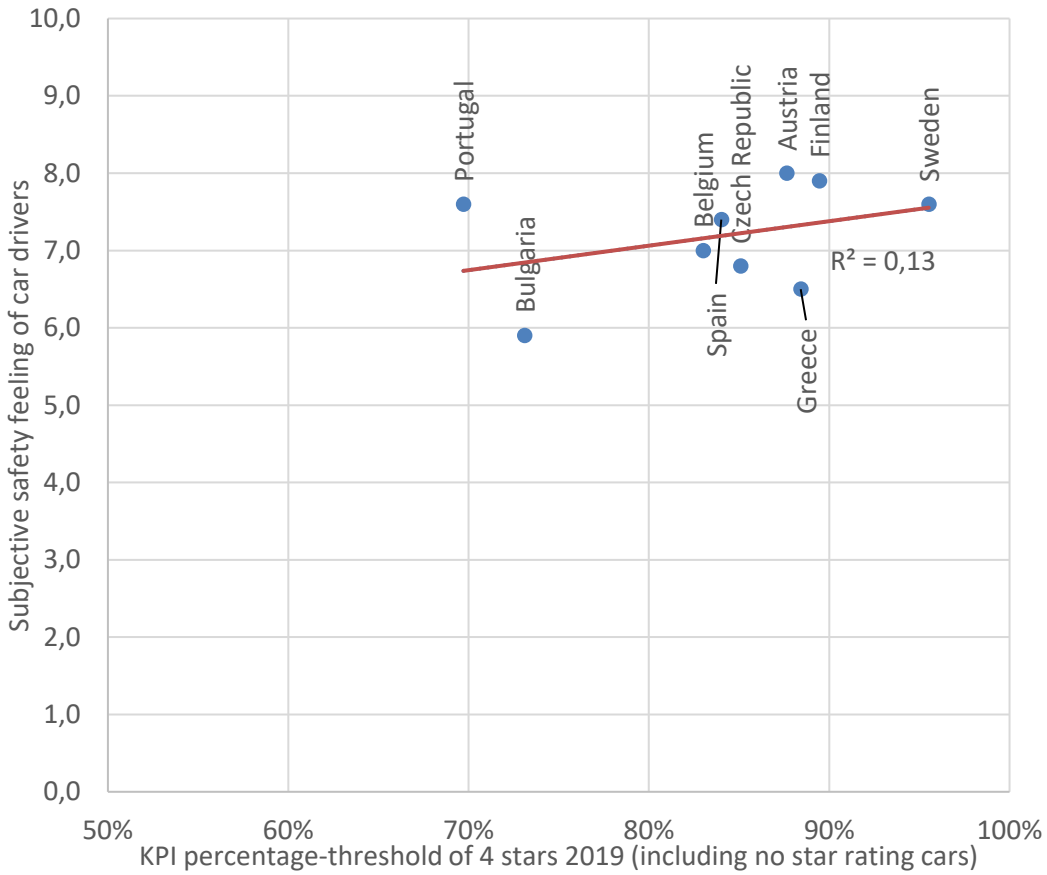
**The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

There is a moderate negative correlation between the KPI percentage-threshold of 4 stars 2019 and average age of the vehicle fleet (passenger cars) of -0.41. Subsequently it can be stated that countries where there is a high percentage of newly registered passenger cars that have a Euro NCAP star rating of at least 4, have a lower average age of passenger car fleet and the opposite.

3.3.2 Relation between KPI percentage-threshold of 4 stars (including no star rating cars) 2019 and subjective safety feeling of car drivers and car passengers

Figure 14 shows the relation between the KPI percentage-threshold of 4 stars in 2019 (including no star rating cars) and the safety feeling of car drivers as measured in ESRA2 (Meesmann et al., 2022) for all countries for which both indicators are available (9 countries).

Figure 14. Scatterplot KPI percentage-threshold of 4 stars 2019 (including no star rating cars) and subjective safety feeling of car drivers

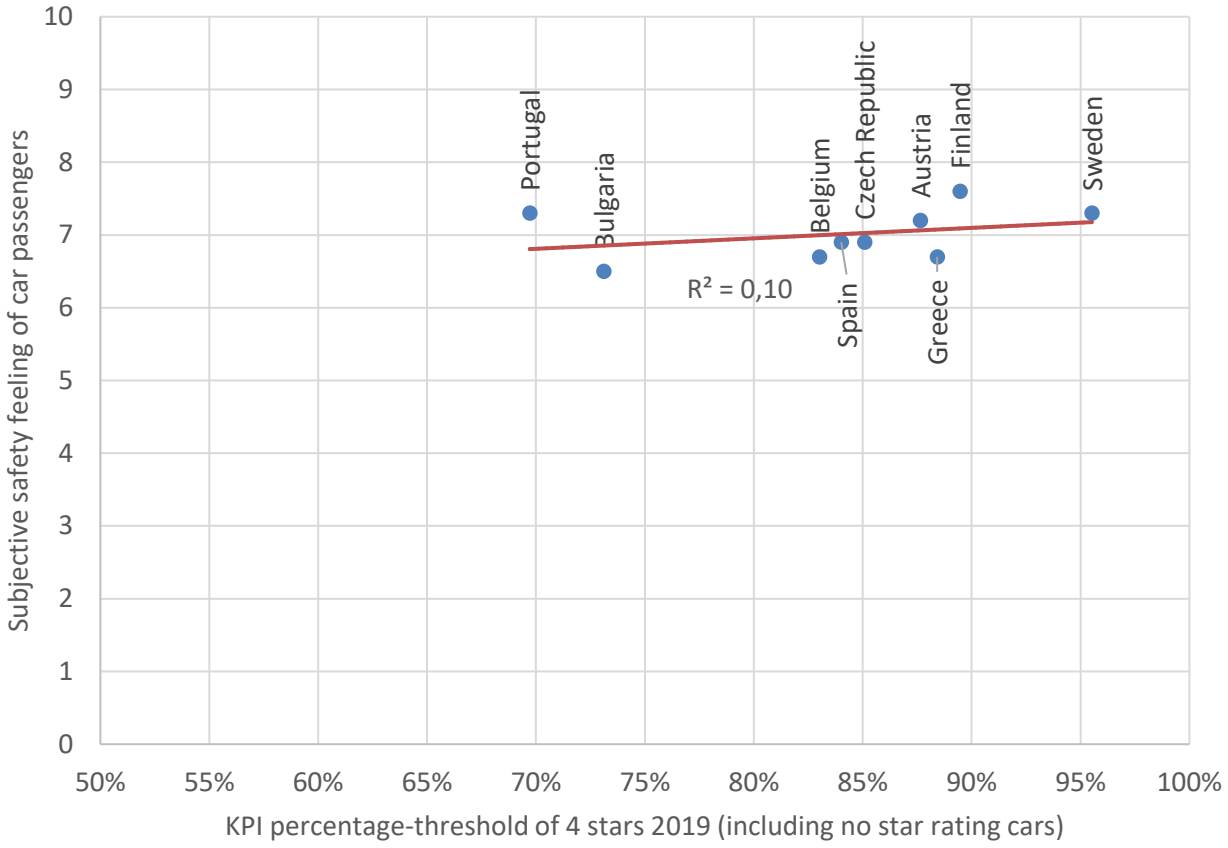


Source subjective safety feeling of car drivers: ESRA2 (2022)

A moderate positive correlation of 0.37 is found between the KPI percentage-threshold of 4 stars in 2019 (including no star rating cars) and subjective safety feeling of car drivers. So, the higher the KPI on Vehicle Safety in the country, the safer car drivers feel on average.

Figure 15 shows the relation between between the KPI percentage-threshold of 4 stars in 2019 (including no star rating cars) and the safety feeling of car passengers as measured in ESRA2 (Meesmann et al., 2022) for all countries for which both indicators are available (9 countries).

Figure 15. Scatterplot KPI percentage-threshold of 4 stars 2019 (including no star rating cars) and subjective safety feeling of car passengers



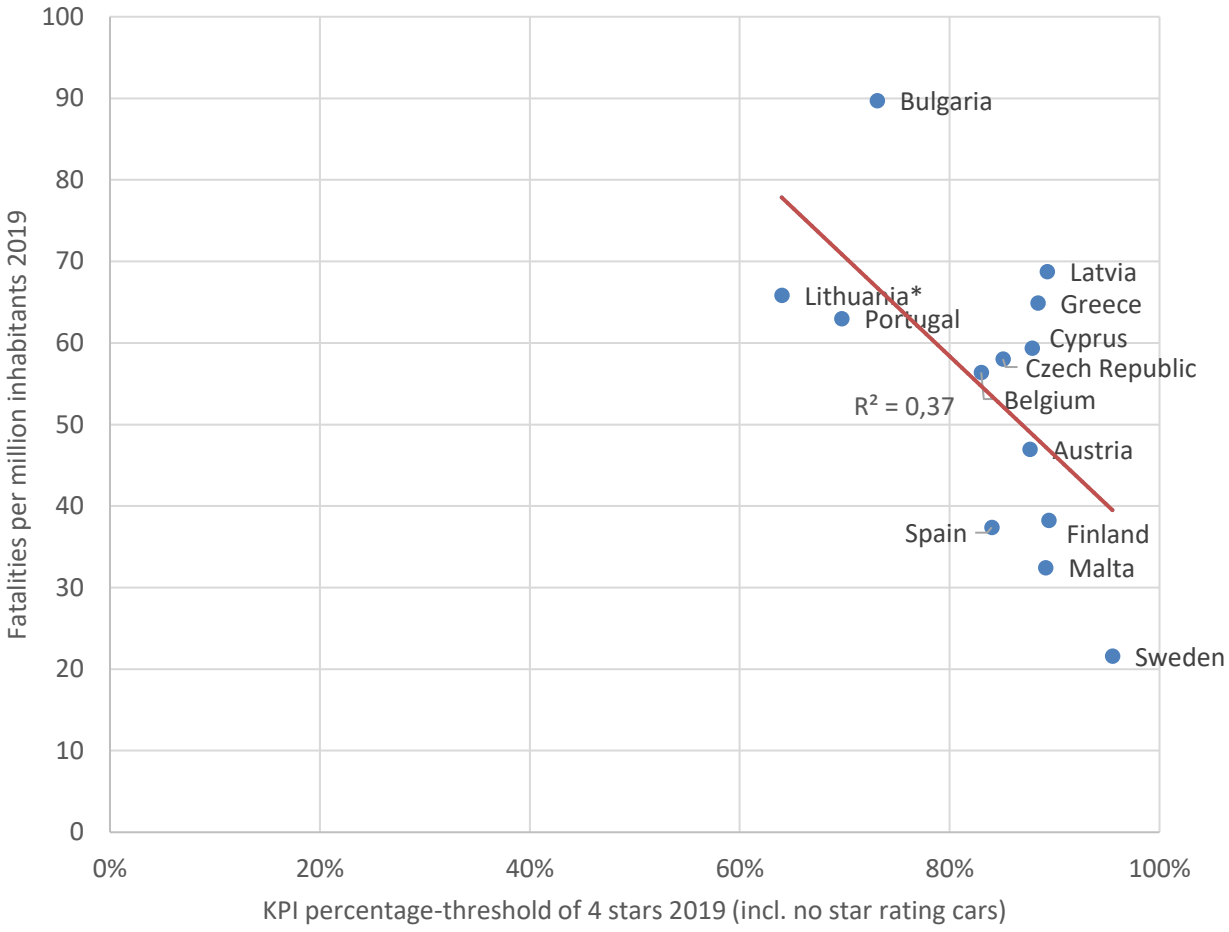
Source subjective safety feeling of car drivers: ESRA2 (2022)

A moderate positive correlation of 0.32 is found between KPI percentage-threshold of 4 stars 2019 (including no star rating cars) and the safety feeling of car passengers. So there is a tendency that countries where there is a higher percentage of newly registered passenger cars that have a Euro NCAP star rating of at least 4, car passengers feel on average safer.

3.3.3 Relation between KPI percentage-threshold of 4 stars (including no star rating cars) 2019 and fatalities per million inhabitants

Figure 16 shows the association between the KPI percentage-threshold of 4 stars in 2019 (including no star rating cars) and the number of fatalities per million inhabitants in 2019 (European Commission, 2021a) for all countries who delivered the KPI on Vehicle Safety.

Figure 16. Scatterplot KPI percentage-threshold of 4 stars 2019 (including no star rating cars) and fatalities per million inhabitants in 2019



Source fatalities per million inhabitants 2019: European Commission (ERSO) (2021a).

**The KPI of Lithuania is the lowest of all countries, as car manufacturers use Lithuania's lower taxes to register vehicles that never drive on Lithuanian roads as they are immediately re-exported to other markets in the European Union as used models with 0 km. For Lithuania, for instance Fiat does this on a large scale, and as the Fiat 500 has a 3-star rating, the KPI is influenced to a large extent. Car manufacturers registering cars in one country and exporting immediately to another for tax reasons is also present in other countries. It is unclear to which extent it influences the KPI in other countries.*

The correlation between the KPI percentage-threshold of 4 stars in 2019 and the number of fatalities per million inhabitants in 2019 is -0.61 which can be considered as a strong negative association. The higher the percentage of newly registered passenger cars that have a Euro NCAP star rating of 4 or higher in the country in 2019, the lower the number of fatalities per million inhabitants in 2019.

It could also be interesting to study the relationship between the KPI on Vehicle Safety and fatalities per million inhabitants for passenger cars only, as well as the relationship between the KPI and crash severity for passenger car occupants.

4 Conclusions on data quality and recommendations for the future

4.1 Quality and comparability of data

The Baseline KPI on Vehicle Safety is a first attempt to compare European countries in terms of vehicle safety. Thirteen countries delivered the Baseline KPI on Vehicle Safety and they all delivered the standard KPI which is defined as the "Percentage of new passenger cars with a Euro NCAP safety rating equal or above a predefined threshold".

For the KPI on Vehicle Safety, there occur no large methodological issues that pose a threat to comparability between countries. For all countries, the KPI is calculated in the same way and the KPIs can be compared with each other. There is however another important issue that may affect the comparability between countries. As mentioned before, some car manufacturers register cars in one country and export those cars immediately to another country of the European Union market for tax reasons. The extent of the effect of this phenomenon on the KPIs of the different countries is unclear and hard to estimate. Most likely the extent of this effect differs among countries. Consequently, this phenomenon affects the comparability of the current KPI Vehicle Safety between countries.

Possible differences in the linking process between the list of newly registered passenger cars and the list of Euro NCAP ratings between the countries can also have an effect on the comparability between the KPIs. The extent of this effect is also unknown. For more info in this see the examples in the recommendation on more detailed guidelines in the next section.

4.2 Recommendations

The current KPI on Vehicle Safety has a lot of shortcomings and could be improved. The main recommendations for the Baseline KPI Vehicle Safety can be summarized as follows:

1. An issue that already was discussed is that some car manufacturers register cars in one country and export immediately to another country of the European Union for tax reasons. This happens not only in Lithuania but also in other countries and it cannot be estimated to what extent each country is affected. As a result, the calculated national KPIs do not fully correspond to the actual fleet of new passenger cars becoming part of traffic in each country. So the validity of the current KPI is less than initially hoped. It would be interesting to map the effects of this phenomenon on the current KPI. It is also recommended that this phenomenon could be taken into account in the future calculation of the KPI in order to better reflect the safety of the actual fleet of new passenger cars entering the vehicle fleet in each country.
2. A larger shortcoming of the current KPI is that only new passenger cars registered in the last year are taken into account. It would be better to develop a Vehicle Safety indicator that covers the whole vehicle fleet. However, this is a major challenge for several reasons. A complete Euro NCAP safety rating currently exist only for passenger cars. The Euro NCAP rating system is also evolving continuously, as technology evolves and new innovations become available (Euro NCAP, 2022a) and thus test protocols advance. Therefore, existing Euro NCAP ratings are only valid for six years. So if the entire vehicle fleet should be covered, a rescaling of the existing Euro NCAP star ratings is needed. Additionally, covering the whole vehicle fleet would also require data from vehicle inspection services. The evaluation of the whole vehicle fleet cannot be limited to the situation of the vehicle at the registration phase, but it should also take into account the safety level after being in traffic for several years.
3. Based on the current experience and the questions posed by the Member States during the calculation of the KPI, it is concluded that the guidelines for the KPI Vehicle Safety should be more detailed in specific topics, especially regarding the linking of the passenger car models with Euro NCAP ratings. For instance, when linking the newly registered passenger car models with the Euro NCAP safety ratings, the year of construction of the registered car model should ideally be taken into account. For example, a car registered in the year 2020 could be either a model of 2019 or a model of 2020, with the respective Euro NCAP ratings being different. However, due to lack of specific guidelines, this issue was not tackled in the same way by all participating countries, affecting also the comparability of the KPIs among the countries. Some countries probably took, out of necessity or convenience, the year of registration as a proxy for year of construction of the registered car. Another issue that came up was the registration of vans as passenger cars (for example camper vans). Some countries might have included those vans in the total fleet of newly registered passenger cars. In this case, given that these vans do not have a Euro NCAP rating, they are included in the cars without Euro NCAP star rating. Other countries might have excluded these cars from the total of

passenger cars. Thus, future guidelines for the calculation of the KPI on Vehicle Safety should be more clear on this issue.

4. Alternative KPIs for Vehicle Safety may not be needed to be collected in future. None of the countries delivered one of the two alternative KPIs as an alternative for the standard KPI on Vehicle Safety. They either delivered the standard KPI or delivered no KPI for Vehicle Safety at all.

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6 Annex 1. Requirements for the calculation of the KPI Vehicle Safety

6.1 Calculation of the KPI

6.1.1 Standard KPI: percentages of new passenger cars meeting or exceeding the threshold

For the standard indicator, the following data is required (for each year for which the KPI is calculated):

- the total number of new passenger cars registered
- the distribution of new passenger cars registered by Make/Model, i.e. how many new passenger cars have been registered for each Make/Model
- the most recent valid Euro NCAP star rating for each of the car passenger models (where applicable)
- the numbers of stars to be used as a threshold.

The total number of new ***passenger cars registered*** can be obtained from international sources such as ACEA (e.g. ACEA Pocket Guide 2020-2021 - https://www.acea.be/uploads/publications/ACEA_Pocket_Guide_2020-2021.pdf) and Eurostat.

The ***distribution of new passenger car models registered by Make/Model*** needs to be obtained from national sources, typically the public authority or agency that registers new cars. These figures may also be obtained from other sources such as international organisations, car related national associations and federations.

The ***Euro NCAP star ratings*** for each of the car passenger models sold is available on the Euro NCAP website but are included in a database prepared for the Baseline partners by Euro NCAP.

As to the ***safety threshold***, it is suggested to use in a first stage, two thresholds:

- a 'minimum' threshold, corresponding with a 4-star rating
- a 'strong' threshold corresponding with a 5-star rating.

After collecting all this data, the first step in the calculation of the KPI consists is linking the Make/Model items with the vehicle model categorization used in the national database. It should be noted that the categorization of vehicle models into 'Makes' and 'Models', as used by Euro NCAP, is a simplification of a more complex reality. From a formal point of view, vehicles are defined by 'Make', 'Type', 'Variant', 'Version' and 'Commercial Description', as specified in the Council Directive[2] 1999/37/EC of 29 April 1999. So sometimes it may not be straightforward to link the 'Model' with the 'Type', 'Variant', 'Version' and 'Commercial Description').

It may therefore be necessary to first create a conversion table between the variables used in the national database and the model names used in the Euro NCAP dataset. The table below is an example of a part of a conversion table made in the Netherlands, used to link the commercial name of the vehicle with the Euro NCAP Model name.

Make	Commercial name	Model in Euro NCAP database
AUDI	A1 SPORTBACK	A1
BMW	420I	4-Series
BMW	X1 SDRIVE20I	X1
CITROEN	C1	C1
FORD	FIESTA	FIESTA
FORD	FIESTA	FIESTA
HYUNDAI	IX20	IX20
HYUNDAI	KONA	KONA
KIA	CEED	CEED
MERCEDES-BENZ	A 160	A-CLASS
NISSAN	NISSAN QASHQAI	QASHQAI
NISSAN	NISSAN LEAF 30KWH	LEAF

[2] See References and the following link: https://eur-lex.europa.eu/eli/dir/1999/37/oj/eng)

NISSAN	NISSAN QASHQAI	QASHQAI
OPEL	KARL ROCKS / VIVA ROCKS	KARL
PEUGEOT	208	208
RENAULT	CLIO	CLIO
RENAULT	KADJAR	KADJAR
RENAULT	ZOE	ZOE
SEAT	ARONA	ARONA
SEAT	ATECA	ATECA

The conversion table can then be used to group the number of newly registered cars by Make+Model, and then link it to the Euro NCAP star score. The result could then look like in the table below

Make	Model	Count	Star Rating	Year of Test
		46425		
Alfa Romeo	Giulia	522	5	2016
Alfa Romeo	Giulietta	408	3	2017
Alfa Romeo	Stelvio	288	5	2017
Audi	A3	4022	5	2012
Audi	A4	2669	5	2015
Audi	A5	1411	5	2015
Audi	A6	1272	5	2011
Audi	A6	229	5	2018
Audi	Q2	1729	5	2016
Audi	Q3	552	5	2011
Audi	Q3	6	5	2018
Audi	Q5	496	5	2017
Audi	Q7	54	5	2015
Audi	TT	32	4	2015
BMW	i3	1631	4	2013
BMW	X1	2306	5	2015
BMW	X2	694	5	2015
BMW	X3	1279	5	2017
BMW	X4	111	5	2018
BMW	X5	38	5	2018
Citroen	Berlingo	113	3	2014
Citroen	Berlingo	7	4	2018
Citroen	C1	4174	3	2012
Citroen	C3	4520	4	2017
Citroen	C3 Aircross	2206	5	2017
Citroen	C4 CACTUS	1806	4	2014
Total		**471806**		

If the EU Type Approval number is available in the national databases of new cars registered, this variable can also be used to make the link with the Euro NCAP database. This Type Approval Number is, however, not available in the database for all the cars tested by Euro NCAP.

In a few cases, the database file with Euro NCAP star ratings contains two ratings for the same model.

- One possibility is for instance the Honda Jazz for which ratings are available for 2015 and 2020. For cars registered in 2019, the rating of 2015 should be used; for cars registered in 2020, the rating of 2020 should be used.
- Another possibility is that ratings are available for 2019 or 2020 but that production of that model only started in that year, but that safety ratings are available for a previous year. For example, for the KIA Sorrento, ratings are available for 2014 and for 2020, but production of the new model only started in July 2020. This means that, strictly speaking, for many of such cars the rating of 2014 should be used. It may be difficult to know exactly which share or newly registered cars should get the old rating and which share the new one. It is proposed that in such cases, 50% of these registrations get the old rating and 50% the new rating.

In the final step one needs to calculate the total number of all new passenger cars that meet the threshold (i.e. 4+5 or 5) and divide this number by the total number of new passenger cars registered. If a Member State prefers to use only one threshold, it is recommended to use the threshold '5-star'.

The data file in which the data has to be reported foresees two versions of the KPIs. The first version ignores the vehicles for which no Euro NCAP star rating is available. If for, e.g. 50 of 1000 new vehicles registered, no Euro NCAP star rating is available, the KPI is calculated for 950 vehicles. In the second version, the vehicles for which no Euro NCAP star rating is available are included in the calculation (which is equivalent to have them a star rating lower than 4). By definition, this second version of the KPI will have a slightly lower value than the second one.

The KPI should be calculated for each year separately. It is proposed to make the calculation at least for 2019 and 2020, but Member States can calculate the indicators for more years if they wish to do so.

6.1.2 Calculation of the alternative indicators

The ***average age of the vehicle fleet*** can be obtained from ACEA (https://www.acea.be/statistics/article/average-vehicle-age). The Baseline project coordinator of Baseline will collect these data and put them in the Baseline database. National Baseline project partners can react on these figures in case they consider these not to be correct.

For the percentage of passenger cars that are ***roadworthy***, at present the roadworthiness criteria and thresholds to be used have not yet been defined. Possibilities include:

(a) the average distance driven (in km) by vehicles undergoing technical inspection, based on odometer reading
(b) the average time between the theoretical date of inspection and the actual one
(c) % of vehicles inspected with any major or dangerous deficiency in technical inspections
(d) % of vehicles inspected with any major or dangerous deficiency in roadside inspections
(e) % of vehicles not showing up to the periodical inspection.

These KPIs are proposed because they are based on data recording which is mandatory according to European Directives (Directive 2014/45/EU and Directive 2014/47/EU 2015 – see references at the end of these guidelines). For instance, the definition of deficiencies is in Directive 2014/45/EU, art 7, and the consequences in art 9. Moreover, certain data on vehicle inspection has to be communicated to national authorities and the European Commission.

It is suggested that Member States considering to use such indicators should explore with the KPI Expert Group on Vehicle Safety which common roadworthiness criteria to consider. If roadworthiness data is based on vehicle inspection, Baseline project partners should make sure to

- specify which roadworthiness criteria have been used
- indicate which part of the vehicle fleet is not covered by the figures (e.g. cars which are not yet required to undergo vehicle inspection)
- only report data that are related to passenger cars.

6.2 Sources of data

6.2.1 Data on the distribution of new passenger car models registered

The distribution of new passenger car models registered needs to be obtained from national sources, typically the public authority or agency that registers new cars. These figures may also be obtained from other sources such as car related national associations and federations. From certain sources this data is not free of charge and needs to be purchased. International commercial sources that can be consulted for obtaining such car sales data are JATO (www.jato.com) and Carsalesbase (carsalesbase.com).

There could be small discrepancies between the figures of different sources, depending on the classification and counting method used.

6.2.2 Vehicle safety data

A database (in Excel format) with Euro NCAP data has been developed and is available to the Baseline project partners. It includes, for every passenger model the following data:

- Make
- Model
- Make + Model
- Type Approval Number
- Year in which the technical safety assessment has been conducted
- Year in which the production of the model started
- Euro NCAP car category
- Overall safety rating *(number of stars)*
- AOP (Adult Occupant Protection) score *(%)*
- COP (Child Occupant Protection) score *(%)*
- VRU (Vulnerable Road User) protection score *(%)*
- SA (Safety Assist) score *(%)*
- AEB (Automatic Emergency Break) Car-to-Car *(Standard / Optional / Not available)*
- AEB (Automatic Emergency Break) Pedestrian *(Standard / Optional / Not available)*
- AEB (Automatic Emergency Break) Cyclist *(Standard / Optional / Not available)*
- LA (Lane Assist) System *(Standard / Optional / Not available)*
- SA (Speed Assist) System *(Standard / Optional / Not available)*
- ESC (Electronic Stability Control) *(Standard / Optional meeting fitment / Not available)*

The database only includes variables for car models that have been tested since 2013, since Euro NCAP ratings have only a validity of six years.

6.2.3 Data on the age of the passenger car fleet

The average age of the vehicle fleet can be obtained from ACEA (https://www.acea.be/statistics/article/average-vehicle-age). The Baseline project coordination team will collect these data and put them in the Baseline database. National Baseline project partners can react on these figures in case they consider these not to be correct.

6.2.4 Data on roadworthiness of passenger cars

This data needs to be obtained from the authorities supervising the technical vehicle inspection. The whole country should be covered. In case this is not possible, it should clearly be indicated which part of the country or of the car passenger fleet that is not covered, and whether this may create a bias on the percentage provided.

The Baseline project coordination team, in cooperation with CITA, will explore with the European Commission which data on roadworthiness could be obtained from European data sources, which can be given to interested Baseline partners in view of calculating one or more alternative KPIs based on roadworthiness.

6.3 Data to be provided

6.3.1 Minimal requirements for the standard indicator

- Number of new registered passenger cars per make and model:
  - for 2019
  - for 2020
- KPI percentages for 2019:
  - using a threshold of 4 stars (ignoring the cars for which no star rating is available)
  - using a threshold of 5 stars (ignoring the cars for which no star rating is available)
  - using a threshold of 4 stars (including the cars for which no star rating is available)
  - using a threshold of 5 stars (including the cars for which no star rating is available)
- KPI percentage for 2020:
  - using a threshold of 4 stars (ignoring the cars for which no star rating is available)
  - using a threshold of 5 stars (ignoring the cars for which no star rating is available)
  - using a threshold of 4 stars (including the cars for which no star rating is available)
  - using a threshold of 5 stars (including the cars for which no star rating is available)
- Metadata:
  - source(s) of the number of new vehicles registered
  - which models and types of cars are missing (because the database on newly registered vehicles is incomplete or because no EuroNCAP ratings are available)
  - which percentage of the new vehicles registered is missing (because the database on newly registered vehicles is incomplete or because no EuroNCAP ratings are available)
  - issues encountered during the linking process
  - the percentage of new vehicles per year in relation to the entire vehicle fleet.

Baseline project participants will be provided with a data file template in Excel in which the data can be entered.

6.3.2 Minimal requirements when using one or more roadworthiness indicators

- KPI averages (KPI indicators type (a) or (b)) or percentages (KPI indicators type (c), (d) or (e)) for 2019
- KPI averages (KPI indicators type (a) or (b)) or percentages (KPI indicators type (c), (d) or (e)) for 2019
- Metadata:
  - source(s) of the data on roadworthiness
  - roadworthiness criteria used
  - whether only passenger cars are included or not
  - which part of the fleet is excluded from the data and why (e.g. no need for vehicle inspection)
  - issues encountered during the calculation process