SG4: Service life

Last update 08/04/2024

Concept

Service life :

- Service life : Period of time during which a product in use meets or exceeds the performance requirements (DIN EN ISO 14067, Feb. 2019) => from SG3 discussion
  - Feedback from last meeting: include millage as well as years of service

- For EV: Virtual millage* related to V2X can not be used as it is not know beforehand the quantity of usage of V2X.
  => Potential discussion ?: Should not be considered for phase 1 discussion

- Service life strongly depends on regional use conditions. For a same vehicle service life may vary from one region to other.
  => Potential discussion ?: Should be defined by each region but should be reported clearly to do a faire comparison between vehicles from different regions of the world

**Virtual millage : Virtual distance is a value in km, equivalent to the battery energy discharged due to V2X or non-traction purposes*

Concept

Service life : Potential use

1] Potential Functional unit: /vehicle

$$CO_{2e} = CO_{2e\ Material} + CO_{2e\ Production} + \mathbf{CO_{2e\ Use\ phase}} + CO_{2e\ Recycling}$$

$$CO_{2e} = CO_{2e\ Material} + CO_{2e\ Production} + \mathbf{(EC\ X\ CF\ X\ Service\ life) + CO_{2e\ maintenance} + CO_{2e\ leakage}} + CO_{2e\ Recycling}$$

2] Potentiel Functional unit : /km

Functional unit = CO_{2e} /Service life

$$= \frac{CO_{2e\ Material} + CO_{2e\ Production} + \mathbf{(EC\ X\ CF\ X\ Service\ life) + CO_{2e\ maintenance} + CO_{2e\ leakage}} + CO_{2e\ Recycling}}{\mathbf{Service\ life}}$$

- Depending upon usage service life will impact the ‘functional unit’ differently

Concept

Service life :

Key feedbacks:

- Different service life used by OEMs => not harmonized
- Service life values varies between standards => not harmonized
- Different service life per region => EU vs US vs BR
- Different service life per powertrain => diesel vs petrol
- Different service life per segment => small vs medium vs large

Open questions :

- Different service life per region => region will decide the value ? Present orientation is to decide service life at region level
- Different service life per region per powertrain ? => Present orientation is not to distinguish between powertrain due to comparability between different powertrains
- Different service life per region per segment ? => Present orientation is to consider vehicle segments in level concept . More discussion in next meeting.
- Initial years consume more energy => Dynamic energy modeling or not ? If YES how to handle ? If NOT how to justify ?
- Significant share of vehicle leave country of registration => how to handle ? If NOT how to justify ?

Concept

Service life : Potential solutions for guideline

	Options	Explanations	Advantage	Disadvantage
Fixed values	Option 1: Generic global	Fixed value for all vehicles worldwide ▪ For example (M1) : 180 000 kms	▪ Easy to compare between vehicles worldwide	▪ Does not reflect real life use or regional use behavior
	Option 2: Generic regional value (Fixed value)	Fixed minimum service life for all passenger cars: defined by each region ▪ For example (M1) : 200 000 kms for EU , 150 000 kms for China etc.	▪ Easy to compare between vehicles in a same region	▪ Does not reflect real usage of different vehicles or segments
	Option 3: Generic regional value per **segment** (Fixed value)			
Variable values	Option 4: OEM declared value (**lower or** higher value for each model)	Fixed minimum service life with a possibility that OEM can declare more service life (with a verification clause) ▪ For example (M1) : 250 000 kms or, 300 000 kms or, 350 000 kms	▪ Reflects real usage intended by OEM	▪ Potential risk of very high declared service life ▪ Will not be easy to compare between vehicles of the same segment of same region
	Option 5: OEM declared value with cap (> fixed value with a possibility to go for min or max value)	Possibility that OEM can declare more service life (with a maximum per region) ▪ M1 (example) : OEM 350 000 kms but maximum possible for region is 300 000 km	▪ Reflects real usage intended by OEM	▪ Will not be easy to compare between vehicles of the same segment of same region

Technical justifications

Service life: Other existing (or draft) standards

Other standards	Service life
China (draft)	Fixed value of 150 000 km and 13 years
PFA	Fixed value according to segments and 15 years
EPD draft	Fixed value according to segments
Transensus discussion	tbc
EPD-PCR Passenger cars-Draft	200 000 km
VDA	Fixed value according to segments
Japan	tbc
Korea EPD	225,000 km for 15 years
Green NCAP	240 000 km for 16 years

To be completed during the meeting

Segment	Mileage (k km)	Lifespan
A-SEGMENT	150	15 years
B-SEGMENT		
C-SEGMENT	225	
D-SEGMENT		
E-SEGMENT	270	
F-SEGMENT		
CDV / VAN1-VAN2	270 / 300	

PFA /EPD values

Concerning a vehicle's mileage, either a fixed mileage of 200,000 km for all segments or the segment-specific mileages shown in Table 1 shall be used in vehicle LCAs. The selected mileage shall be documented and the LCIA result of the use phase shall be reported separately referencing the selected mileage.

Table 1 Segment specific mileage

Segment according to European Comission	Segment according to KBA	Mileage
A: Very small car (Kleinstwagen)	Minis (Kleinstwagen)	120,000 km
B: Small car (Kleinwagen)	Kleinwagen	to be decided
C: Lower medium sized cars (Mittelklassewagen)	Kompaktklasse	150,000 km
D: Medium cars (Obere Mittelklasse)	Mittelklasse	200,000 km
E: Upper medium cars (Oberklasse)	Obere Mittelklasse	250,000 km
F: Luxury cars (Luxusklasse)	Oberklasse	300,000 km
Sports cars, multi-vans, and SUVs shall be assigned to the corresponding segments		

- Most of the standards (or drafts) propose to use a fixed value (per category or per segment)
- Not all standards use the same definition of service life

Service life: OEM present practice

OEM	Service life	Comment
Renault	200,000 km and 15 years	
Polestar 2 and 4 EV*	200,000 km	
VW	200,000 km	
Hyundai	200,000 km	
GM	200,000 km and 10 years	scope 3 use phase emissions
OEM 4	200,000 km	

To be completed

Not all OEM use the same definition of service life

* https://www.polestar.com/dato-assets/11286/1630409045-polestarlcarapportprintkorr11210831.pdf

Service life: data used in ICCT studies (1/2)

Region	Lifetime (years)	Source	Comment
European Union	18 years	Average age of vehicles when reaching end of life: • Germany (in 2014-2016): **17–18 years** (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2020) • France (in 2018): **19 years** (Ministère de la transition écologique et solidaire, 2019) • Portugal (in 2015): **20 years** (Öko-Institute, 2018) • Poland (in 2015): **20 years** (Öko-Institute, 2018)	These numbers correspond to cars that were produced about two decades ago. As the average vehicle age lifetime has been observed to increase every year (ACEA, 2019), 18 years is considered a conservative estimate for currently produced vehicles.
United States	18 years	Latest data on average age of vehicles when de-registered in the U.S. is from 2003, showing 15-16 years for vehicles produced before/around 1990 (U.S. Department of Transportation, 2006). Average age of LDVs in the U.S. increased from 8.4 years in 1995 to 12.5 years in 2023 (U.S. Department of Transportation, 2024).	Latest U.S. survival curve data is from 2003, for vehicles produced before/around 1990. Applying the increase in average age of about 4 years between 1995 and 2023 to the avg. vehicle lifetime, yields in 19-20 years. 18 years is thus considered a conservative estimate.
Brazil	22 years	50% of vehicles of an age of 22–23 years are still in use in Brazil (Ministry of Science, Technology and Innovations of Brazil, 2020).	

Important: de-registration in a country (i.e., as indicated by "survival curves") can be significantly earlier than reaching end of life.
In some countries, a significant share of vehicles is exported before reaching the end of service life. Here, the average age when being de-registered (e.g., 13 years in Germany) is lower than the average age when being recycled (e.g., 18 years in Germany).

ICCT (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.
ICCT (2023). Comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars in Brazil.

Service life: data used in ICCT studies (2/2)

Region	Lifetime (years)	Annual mileage	Lifetime mileage
European Union	18 years	• Small cars: 11,000 km/a • Lower medium: 13,500 km/a • SUV segment: 15,000 km/a *Based on data from Germany (Bundesanstalt für Straßenwesen, 2017), similar data for EU average by TRACCS (Emisia, 2013).*	• Small cars: **198,000 km** • Lower medium: **243,000 km** • SUV segment: **270,000 km**
United States	18 years	• Passenger cars: 17,444 km/a • SUVs: 18,722 km/a *Average over first 18 years (U.S. Department of Transportation, 2017).*	• Passenger cars: **314,000 km** • SUVs: **337,000 km**
Brazil	22 years	• 13,091 km/a *Average over first 22 years (Ministry of Environment, 2014).*	• **288,000 km**

Annual mileage is higher than average in first years of usage, and lower than average in later years. This needs to be accounted for. In result, (higher) GHG emission intensity of fuel/electricity in first years contributes more to lifetime emissions than (lower) emission intensity in later years.

ICCT (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.
ICCT (2023). Comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars in Brazil.

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Lifetime functions in SIBYL

4/8/2024

Giorgos Mellios

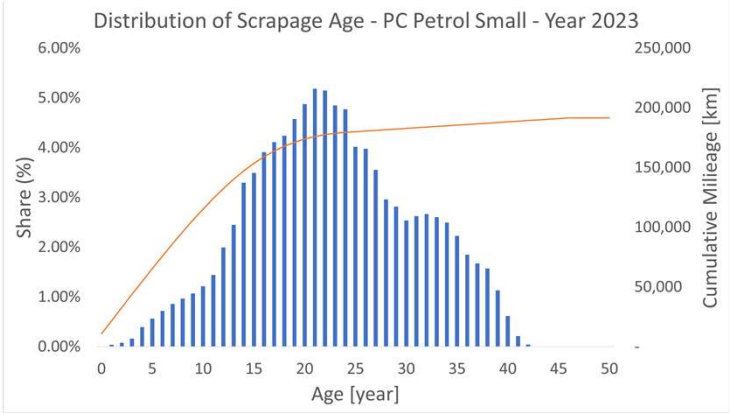
Main data sources

Source	Main information provided
Eurostat	Stock and new registrations per fuel and engine capacity / GVW
EC Statistical Pocketbook (EU Transport in figures)	Stock and new registrations
ACEA	Stock per fuel, new registrations per fuel and per segment / GVW
ACEM	Stock, new registrations per fuel and engine capacity (L-vehicles)
CO_2 monitoring database	New registrations per fuel and segment (PCs and LCVs)
EAFO (European Alternative Fuels Observatory)	Stock and new registrations of alternative fuels (LPG, CNG/LNG, electric, H_2)
NGVA Europe (Natural Gas Vehicle Association) NGV Global (Natural Gas Vehicle Knowledge Base)	Stock of natural gas vehicles
UNFCCC	Fuel sold, based on Eurostat and disaggregated per vehicle category
National statistical institutes	Various information (level of detail is country-dependent)

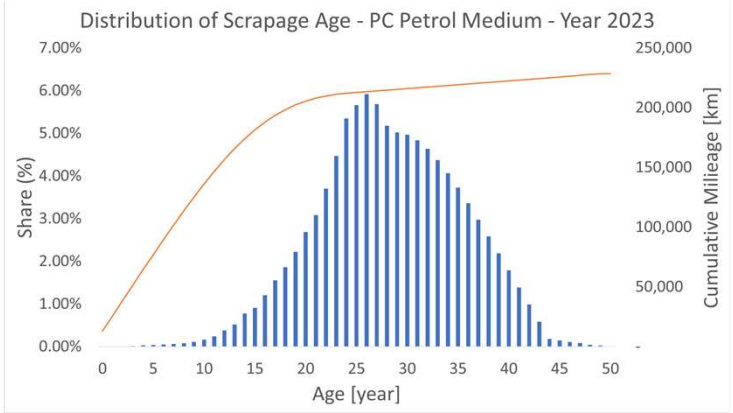
Distribution of scrappage by age and segment in EU – Passenger Car

Petrol

Small



Medium



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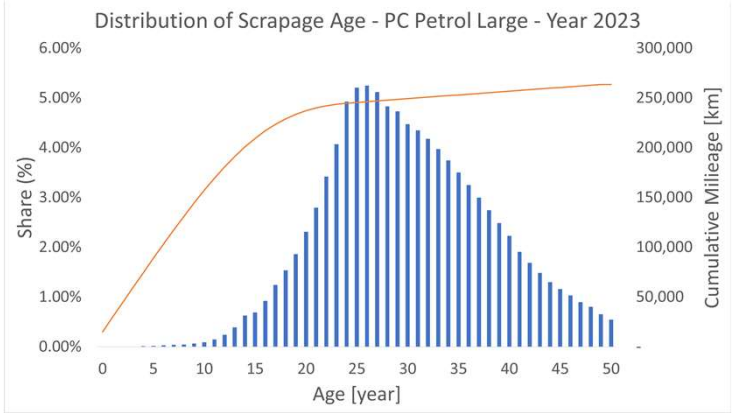
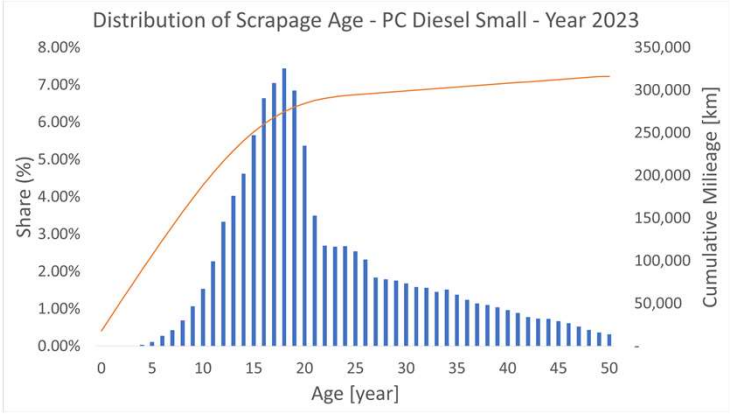
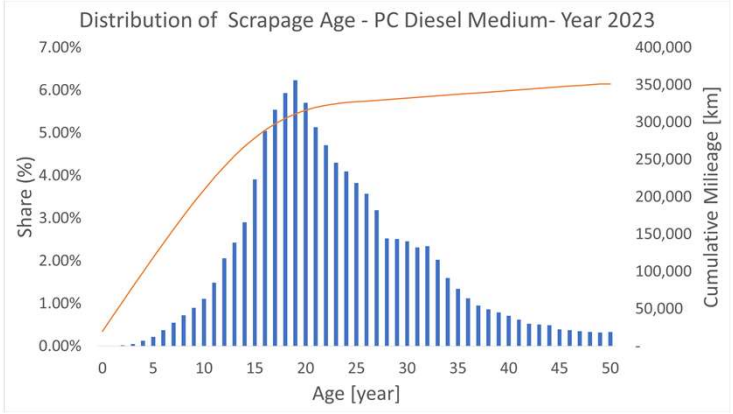
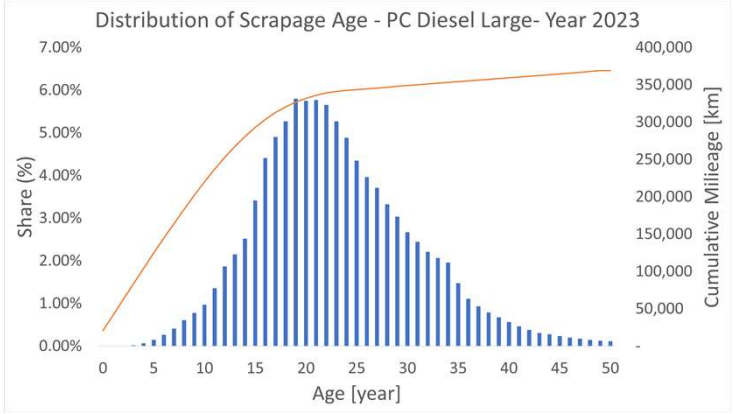


Diesel



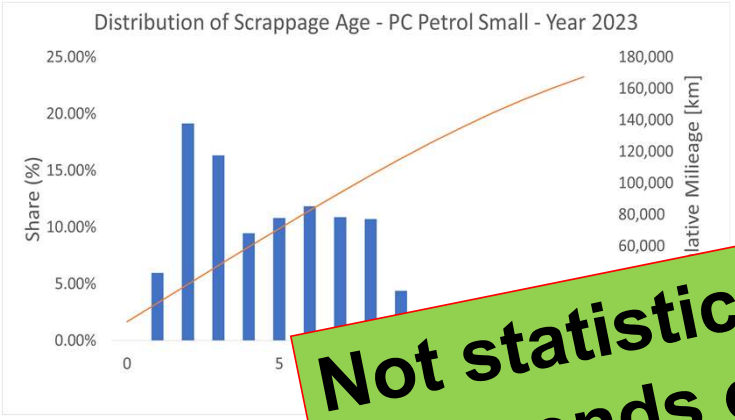




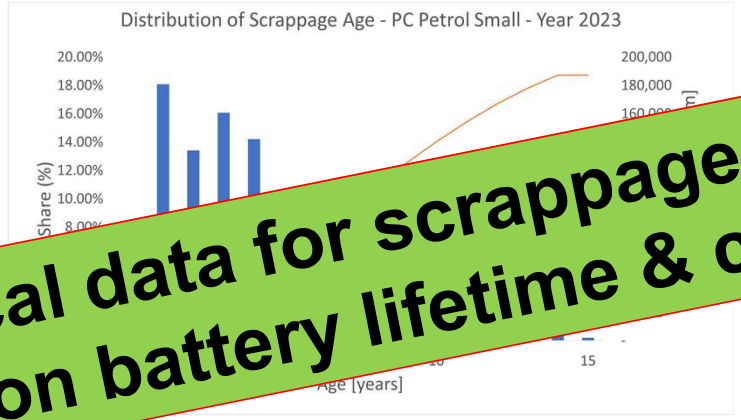
EU Scrappage Age distribution per segment – Passenger Car

BEV

Small



Medium



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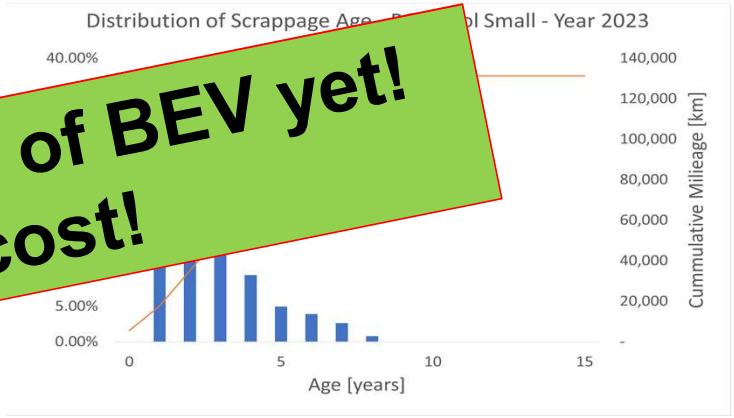
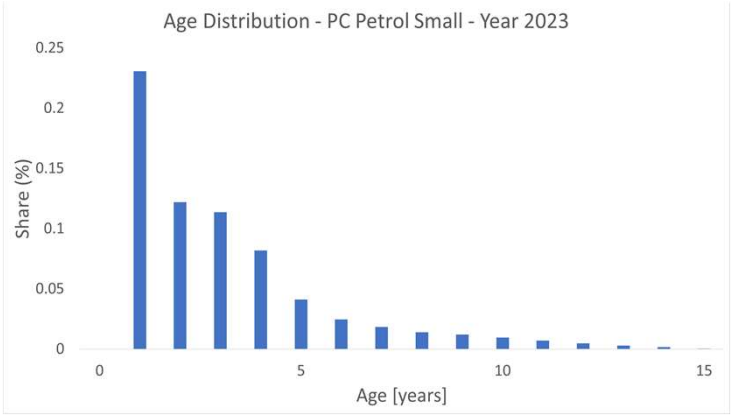
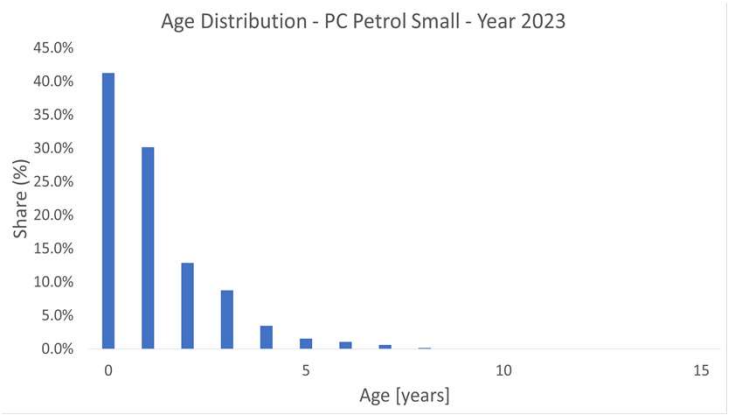


Not statistical data for scrappage of BEV yet!
It depends on battery lifetime & cost!





Average cumulative mileage over lifetime

Vehicle Category	Fuel	Small [km]	Medium [km]	Large [km]	*Average age [years]
Passenger Cars	Petrol	168,000	212,000	247,000	12.3
	Diesel	272,000	308,000	326,000	
	BEV	n/a	n/a	n/a	
Light Commercial	…	…	…	…	12.5
HDTs	…	…	…	…	13.9
Buses	…	…	…	…	12.5
L-Category	…	…	…	…	UNK

ACEA Report – Vehicles in European roads

e:misia

Thank you!

For more information: impact assessments – e:misia (emisia.com)

Previous analyses of lifetime activity for LDVs

Nikolas Hill, Ricardo, 8th April 2024

Previous analyses of LDV lifetime activity

Lifetime km	Passenger car					LCV			
	Small	Lower medium	Upper medium	Large	All	Small	Medium	Large	All
Petrol*	152,099	173,142	183,830	184,654	**160,909**	136,442	150,521	177,312	**146,688**
Diesel**	232,266	252,158	263,350	276,100	**253,438**	195,425	210,271	244,477	**230,038**
All powertrains	**172,219**	**222,968**	**249,342**	**259,133**	**208,815**	**187,637**	**207,623**	**244,102**	**227,480**

•Real-world data basis (2017):

Table 1: Assumptions on vehicle mileage by vehicle segment and powertrain

Source: (CE Delft et al., 2017), (TML et al, 2016) (Ricardo-AEA, 2014a); Aggregation: Ricardo analysis (2023)

Notes: Small = A/B, Lower Medium = C, Upper Medium = D, Large = others. Mileage by powertrain based on statistics for petrol and diesel vehicles; assumptions used in modelling for other powertrains (in brackets).

Lifetime km	Passenger car					LCV		
	Small	Lower medium	Upper medium	Large	All	Small	Medium	Large
Petrol*	155,667	177,068	184,015	213,348	**175,817**		107,455	
Diesel**	225,268	221,250	221,250	273,706	**227,879**		241,836	
All powertrains	**190,143**	**202,243**	**205,149**	**257,698**	**203,337**		**236,178**	

Previous assumptions used in modelling (in the absence of any robust real data):
* Previously assumed to similarly apply to BEVs
** Previously assumed to apply to PHEV/REEV/FCEV

•PRIMES-TREMOVE Modelling for European Commission (2017)

Table 2: Lifetime vehicle mileage by LDV segment and powertrain based on PRIMES-TREMOVE

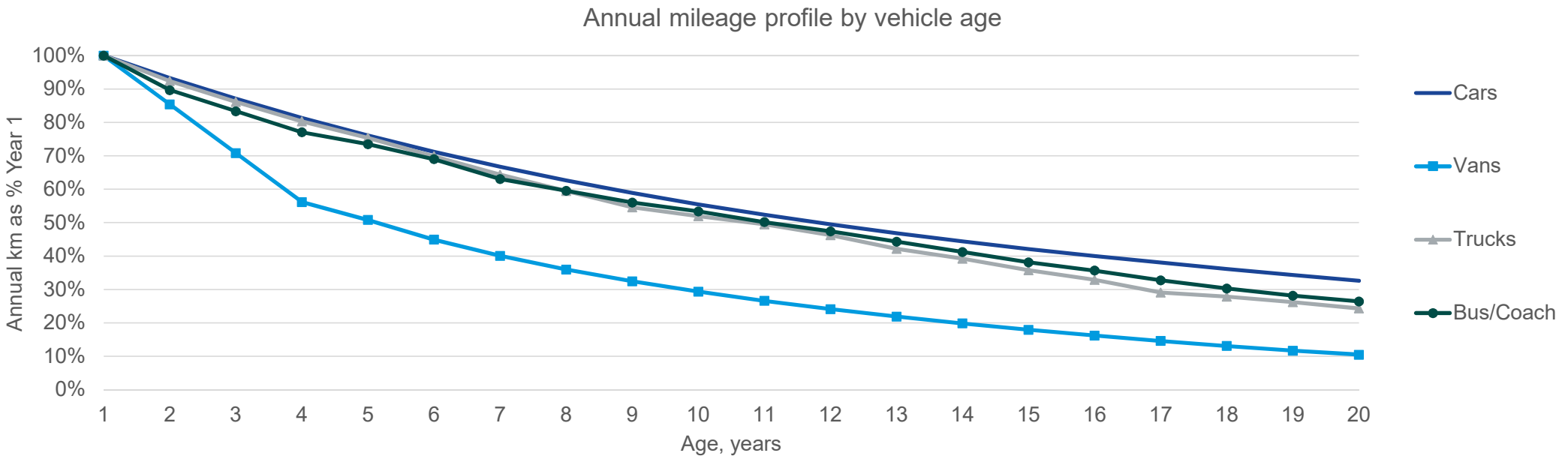
Source: Estimates based on the PRIMES-TREMOVE model assumptions; (Ricardo et al., 2018). Aggregation: Ricardo analysis (2023)

Notes: Small = A/B, Lower Medium = C, Upper Medium = D, Large = others. Mileage by powertrain based on statistics for petrol and diesel vehicles; assumptions used in modelling for other powertrains (in brackets). The PRIMES-TREMOVE model only includes a single aggregated category for LCVs.

Previous analyses of annual km by vehicle age

- Annual km profile by vehicle age (years), based on analysis of EU vehicle datasets*

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Cars	100.0%	93.3%	87.1%	81.4%	76.1%	71.2%	66.8%	62.7%	59.0%	55.5%	52.4%	49.5%	46.9%	44.4%	42.2%	40.1%	38.1%	36.2%	34.4%	32.6%
Vans	100.0%	85.4%	70.8%	56.2%	50.9%	45.0%	40.1%	36.0%	32.5%	29.4%	26.6%	24.2%	21.9%	19.9%	18.0%	16.3%	14.6%	13.1%	11.7%	10.5%
Trucks	100.0%	92.4%	86.2%	80.3%	75.4%	69.9%	64.4%	59.5%	54.6%	51.9%	49.5%	46.3%	42.2%	39.2%	35.8%	32.9%	29.1%	27.9%	26.2%	24.3%
Bus/Coach	100.0%	89.7%	83.4%	77.1%	73.5%	69.0%	63.1%	59.6%	56.1%	53.4%	50.2%	47.4%	44.3%	41.2%	38.2%	35.7%	32.8%	30.3%	28.2%	26.4%



Source: * Ricardo (2020), "Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA", Final report for DG Climate Action, https://climate.ec.europa.eu/system/files/2020-09/2020_study_main_report_en.pdf