

EU-Commission JRC Contribution to EVE IWG:

In-vehicle battery durability e-HDVs: energy capacity fade

68th meeting of the GRPE Informal Working Group
Electric Vehicles and the Environment (EVE)

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Presentation Summary

Follow-up of the JRC activities contributing to the EVE IWG e-HDVs in-vehicle battery durability:

- Extension of JRC TEMA to e-HDVs in-vehicle battery durability scenario studies based on 2019/1242/EU and VECTO mission profiles
- Extension of JRC TEMA to e-HDVs in-vehicle battery durability scenario studies based on literature data of vehicles
- Similar results obtained with the two methods
- Comparison with warranties data overview from EVE-61-08e

Assumption and inputs to JRC TEMA for e-HDVs

- Development HDV scenarios for in-vehicle battery durability based on 2019/1242/EU and VECTO:
 - Vehicle groups, mission profiles, annual kilometer driven (for mission profile and vehicle group), energy consumption (for mission profile and vehicle group), average speed...
- Assumption of battery size for vehicle group and mission profile based on ICCT* report and VECTO;
- New recharges strategies introduced in JRC TEMA for e-HDVs
 - lunch break ultra-fast charging, depot over-night slow charging, mixed of the previous two ones (lunch break ultra-fast charging, depot over-night slow charging) ...
- Battery architecture scenarios from literature
- Same performance based models used for LDVs GTR 22, i.e., NCM-LMO
- Assessment of the battery ageing at Euro7 proposed thresholds and at EoL (80% remaining energy capacity)

*ICCT: The European Heavy-Duty Vehicle Market Until 2040: Analysis of decarbonization pathways <https://theicct.org/publication/hdv-europe-decarb-costs-jan23/>

TEMA Simulations Assumptions

Inputs and assumptions:

- **Vehicle groups**
- **Battery size and architecture and energy consumption**
- **Vehicle speed**
- **Performance based model**
- **Charging strategies**
- **Payload**
- **Electric PTOs**

HDVs group for vehicles of category N (EU) 2019/1242 – VECTO

Elements relevant to the classification in vehicle groups			Vehicle group	Allocation of mission profile and vehicle configuration						Vehicle category	Capacity fade	
Axle configuration	Chassis configuration	Technically permissible maximum laden mass (tons)		Long haul	Long haul (EMS)	Regional delivery	Regional delivery (EMS)	Urban delivery	Municipal utility			Construction
4x2	Rigid lorry	> 3,5 – 7,5	(0)								N2	8y, 300,000km 375,000km
	Rigid lorry (for tractor) (**)	> 7,5 – 10	1			R		R				
	Rigid lorry (or tractor) (**)	> 10 – 12	2	R+T1		R		R				
	Rigid lorry (or tractor) (**)	> 12 – 16	3			R		R			12<N3<16t	8y, 300,000km 375,000km
	Rigid lorry	> 16	4	R+T2		R		R	R		N3>16t	15y, 700,000km 875,000km
	Tractor	> 16	5	T+ST	T+ST+T2	T+ST	T+ST+T2	T+ST				
	Rigid lorry	> 16	4v (***)						R	R		
Tractor	> 16	5v (***)							T+ST			
Rigid lorry	> 7,5 – 16	(6)										
Rigid lorry	> 16	(7)										
Tractor	> 16	(8)										
6x2	Rigid lorry	all weights	9	R+T2	R+D+ST	R	R+D+ST		R		N3>16t	15y, 700,000km 875,000km
	Tractor	all weights	10	T+ST	T+ST+T2	T+ST	T+ST+T2					
	Rigid lorry	all weights	9v (***)						R	R		
	Tractor	all weights	10v (***)							T+ST		
6x4	Rigid lorry	all weights	11	R+T2	R+D+ST	R	R+D+ST		R	R		
	Tractor	all weights	12	T+ST	T+ST+T2	T+ST	T+ST+T2			T+ST		
6x6	Rigid lorry	all weights	(13)									
	Tractor	all weights	(14)									
8x2	Rigid lorry	all weights	(15)									
8x4	Rigid lorry	all weights	16							R		
8x6 8x8	Rigid lorry	all weights	(17)									

(*) EMS European Modular System

(**) In these vehicles classes tractors are treated as rigid lorries but with specific curb weight of tractor

(***) Sub-group 'v' of vehicle groups 4, 5, 9 and 10: these mission profiles are exclusively applicable to vocational vehicles.

T = Tractor

R = Rigid lorry & standard body

T1, T2 = Standard trailers

ST = Standard semitrailer

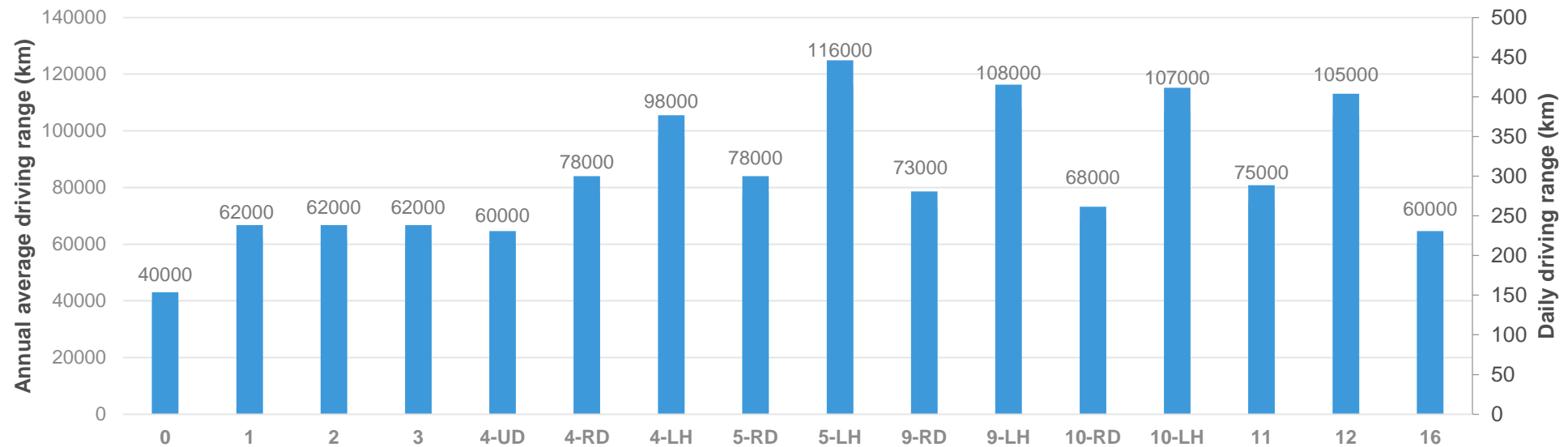
D = Standard dolly

Vehicles

Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC (Text with EEA relevance)Text with EEA relevance <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R1242-20190725&qid=1687357674405>

ICCT: The European Heavy-Duty Vehicle Market Until 2040: Analysis of decarbonization pathways <https://theicct.org/publication/hdv-europe-decarb-costs-jan23/>

Average annual and daily driving range per truck group



Euro 7 proposal

- Part B: Verification of Battery Durability

ANNEX II EURO 7 MINIMUM PERFORMANCE REQUIREMENTS FOR BATTERY DURABILITY

Table 3: Euro 7 Minimum performance requirements (MPR) for battery durability for M₂, M₃, N₂, N₃ vehicles

Battery Energy based MPR	Vehicles in main lifetime*	Vehicles in additional lifetime*
OVC-HEV		
PEV		

*As specified in Annex IV

ANNEX IV

LIFETIME REQUIREMENTS

Table 1: Lifetime of vehicles, engines and pollution control systems

Lifetime of vehicles, engines and replacement pollution control devices	M ₁ , N ₁ and M ₂	N ₂ , N ₃ <16t, M ₃ <7.5t:	N ₃ >16t, M ₃ >7.5t
Main lifetime	Up to 160 000 km or 8 years, whichever comes first	300 000 km or 8 years, whichever comes first	700 000 km or 15 years, whichever comes first
Additional lifetime	After main lifetime and up to 200 000 km or 10 years whichever comes first	After main lifetime and up to 375 000 km	After main lifetime and up to 875 000 km

HDVs vehicle categories: what about the different regions?

lbs	kg	USA vehicle Class	tonnes	EU vehicle group	vehicle category	UN categories		tonnes	JPN Truck group	JPN Tractor group	JPN Route Bus group	JPN Bus group	
6000	2,722	1			N1,M1 and M2<3.5t	categories 1-1, 1-2 and category 2	UN GTR22						
8500	3,856	2			3.5t<M2<5t								
10000	4,536	3	3.5	0	N2<12t 5t < M3 <7.5t M3>7.5t	Category 2 vehicles not exceeding 16 tonnes	UN GTR HDV	3.5-7.5	T1/T2/T3/T4	TT1		B1	
14000	6,350	4	7	0									
16000	7,257	5	7.4	1s								BR1	B2
			7.5	1									
19500	8,845	6	10	2								BR2	B3
26000	11,793	7	12	3							12t<N3<16t M3>7.5t		BR3
33000	14,969	8				BR4	B5						
60000	27,216	8	>16	4,5,9,10,11,12,16	N3>16t M3>7.5t	Category 2 vehicles exceeding 16 tonnes				TT2		B6	
												BR5	B7

➤ With acknowledge to JAMA for their contribution

Vehicle speed

Heavy Duty Vehicles Speed Limits [km/h]				
Trucks	Urban roads	Secondary suburban roads	Main suburban roads	Highways
Up to 3,5 t	50	90	110	130
3,5 – 12 t	50	80	80	100
Over 12 t	50	70	70	80
Construction	40	60		
Construction not at full load	50	70	70	80
Transport of explosives	30	50		
Trucks with a trailer Articulated lorries	50	70	70	80

Cycle	Max. speed [km/h]
Long Haul	85
Coach	100
Interurban	85
Urban	65

* <https://portalepatente.it/limiti-velocita-autocarri/>

Performance based models (SotA)

	Capacity fade		Power fade	
	Calendar	Cycle	Calendar	Cycle
LiFePO₄	Sarasketa-Zabala et Al. (2013/14);	Wang et Al. (2011);	Sarasketa-Zabala et Al. (2013);	
		Sarasketa-Zabala et Al. (2013);		
		Sarasketa-Zabala et Al. (2015);		
NCM + spinel Mn	Wang et Al. (2014);		-	Wang et Al. (2014);
NCM – LMO	-	Cordoba-Arenas et Al. (2014);	-	Cordoba-Arenas et Al. (2015);

Calendar + Cycle (4 Combinations):

#1 (LiFePO₄): Sarasketa-Zabala et Al. (2013/14) model for calendar plus Wang et Al. (2011) model for cycle;

#2 (LiFePO₄): Sarasketa-Zabala et Al. (2013/14) model for calendar plus Sarasketa-Zabala et Al. (2015) model for cycle;

#3 (NCM + Spinel Mn): Wang et Al. (2014) for calendar plus Wang et Al. (2014) for cycle;

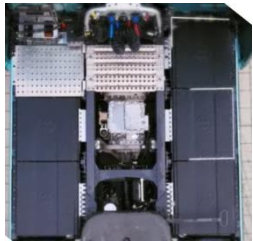
#4 (NCM-LMO): Wang et Al. (2014) for calendar plus Cordoba-Arenas et Al. (2015) for cycle

...other models implemented

Implementation of the performance based models into JRC TEMA (assumptions)

Vehicle Electric Architectures (examples)

HDV 1



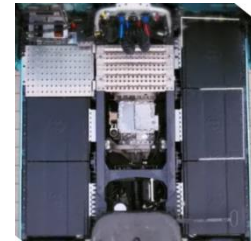
HDV 2



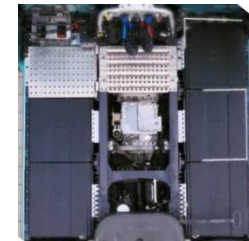
HDV 3



HDV 4



HDV 5



Charging strategies

https://www.transportenvironment.org/wp-content/uploads/2021/07/2020_06_TE_comparison_hydrogen_battery_electric_trucks_methodology.pdf

Max. range without refuelling / recharging

Long-haul 800km

Regional delivery 400km

Normal charge for HDVs:

Specifications of an overnight charger for long-haul (150 kW)

Specifications of an overnight charger for regional delivery (75 kW)

→ $\leq 150\text{kW}$

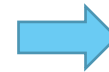
→ Or $\leq 200\text{-}250\text{kW}$?

Ultra-fast charge:

mega charger for long-haul (1.2 MW)

Ultra-fast charger for regional delivery (600 kW)

260 working days per years



Strategy 21 Long haul Opportunistic Lunch Break DC 1.2MW (if Stop > 20 min & after travelled for 4.5hours - charge in DC Mega Charge)

Strategy 22 Regional Opportunistic Lunch Break DC 600kW (if Stop > 20 min & after travelled for 4.5hours - charge in DC Ultra-Fast Charge)

Strategy 23 Long haul Opportunistic Lunch Break DC 1.2MW & Night-charging DC @Depot (if Stop > 20 min && after travelled for 4.5hours - charge in DC MegaCharge && 150kW DC (if time > 10pm or < 7am day after and Stop > 4 hours)

Strategy 24 Regional Opportunistic Lunch Break DC 600kW & Night-charging DC @Depot (if Stop > 20 min && after travelled for 4.5hours - charge in DC Ultra-Fast Charge && 75kW DC (if time > 10pm or < 7am day after and Stop > 4 hours)

Strategy 25 Long haul Night-charging DC @Depot (charge 150kW DC (if time > 10pm or < 7am day after and Stop > 4 hours)

Strategy 26 Regional Night-charging DC @Depot (charge 75kW DC (if time > 10pm or < 7am day after and Stop > 4 hours)

Payload

- Development HDV scenarios for in-vehicle battery durability based on 2019/1242/EU and VECTO reference payload
- Additional scenarios increasing by 20% and 50% the reference energy consumption

e-HDV's PTO



Guastalegname
https://www.politesi.polimi.it/bitstream/10589/79998/3/2013_04_Guastalegname.pdf

	Nominal power	Operational time
crane	24.3 kW	9 h
concrete mixer	68 kW (PTO)	4 h
truck mounted pump	85 kW (PTO)	4 h

Garbage press truck. For the tested loaders the average power for the PTO during PTO operation was about 4-10% of the maximum engine power. TNO-2018-R10313-vs2



<https://rmi.org/insight/electrify-trucking/>

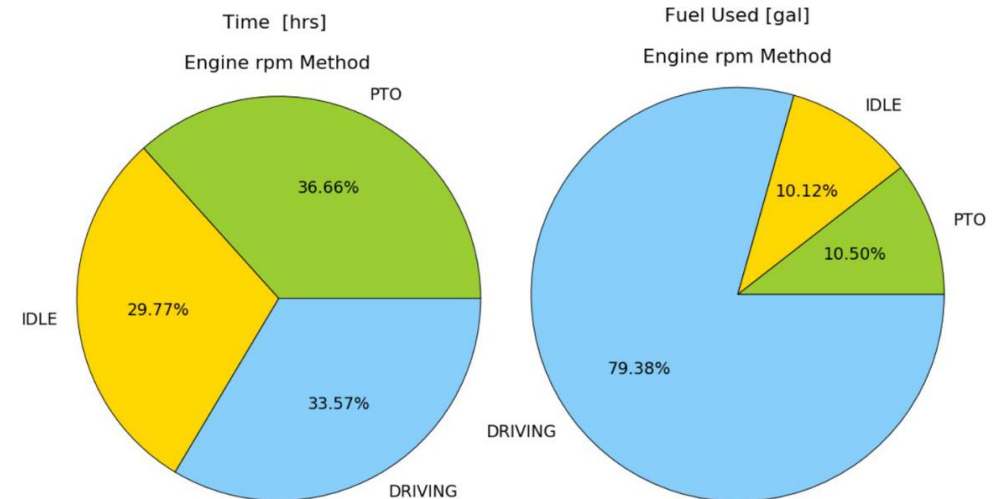


Figure 5. Percent of time [left] and fuel [right] spent in each operating mode

NREL https://afdc.energy.gov/files/u/publication/pto_idle_behavior_utility_vehicles.pdf

JRC TEMA Results

In-vehicle battery durability first estimates for vehicle group and mission profile based on the assumptions

- **Vehicle comparison**
- **Energy capacity fade**
- **Payload**
- **Electric PTO**

En capacity fade at several thresholds in years and km

Legend	
	Capacity fade above and equal 20%
	Capacity fade above or equal to 10% and below 20%;
	Capacity fade below 10%

12t<N3<16t	3	HDV vehicle group	Mission Profile																																							
			Construction ref								Long Haul ref								Municipal Utility ref								Regional Delivery ref								Urban Delivery ref							
			8 y		300000 km		375000 km		EoL@20% capacity fade arch 1		8 y		300000 km		375000 km		EoL@20% capacity fade arch 1		8 y		300000 km		375000 km		EoL@20% capacity fade arch 1		8 y		300000 km		375000 km		EoL@20% capacity fade arch 1									
			w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO					
		Annual km																	62000								673704	62000								810533						
		Years																									8	4.84	6.05	10.87	8	4.84	6.05	13.07								
		En-th																									3.16 E+08	1.91 E+08	2.39 E+08	4.29 E+08	1.87 E+08	1.13 E+08	1.41 E+08	4.29 E+08								
		str22	Arch 1																									15.1	8.5	11.2	12.4	6.4	8.9									
			Arch 2																									13.3	7.0	9.7	11.0	5.3	7.7									
			Arch 3																									10.7	5.0	7.4	9.0	3.7	5.9									
		str26	Arch 1																									13.7	7.4	10.0	11.6	5.8	8.2									
			Arch 2																									11.9	6.0	8.5	10.2	4.7	7.0									
			Arch 3																									9.4	4.0	6.2	8.2	3.1	5.2									

En capacity fade at several thresholds in years and km

HDV vehicle group	Mission Profile																																																																
	Construction ref								Long Haul ref								Municipal Utility ref								Regional Delivery ref								Urban Delivery ref																																
	15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1																																		
	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO																																	
10	Annual km	107000								843679								68000								644164																																							
	Years	15								6.54								8.18								7.88								15								10.29								12.87								9.47							
	En-th	1.76 E+09								7.68E+08								9.61E+08								9.26 E+08								9.63 E+08								6.61 E+08								8.27 E+08								6.08 E+08							
	str22	Arch 1	33.0								17.0								20.6								28.9								21.5								25.7																						
		Arch 2	28.9								14.2								17.6								25.8								18.9								22.9																						
		Arch 3	23.0								10.2								13.1								21.4								15.2								18.7																						
	Str26	Arch 1	NaN								NaN								NaN								25.8								18.9								22.8																						
Arch 2		NaN								NaN								NaN								22.7								16.4								20.0																							
Arch 3		NaN								NaN								NaN								18.4								12.7								15.9																							
11	Annual km	75000								787103		723100		75000								608594				75000								813122				1292695				75000								738739															
	Years	15		15		9.33		9.33		11.67		11.67		10.49		9.64		15		9.33		11.67		8.11		15		15		9.33		9.33		11.67		11.67		10.84		17.24		15		15		9.33		9.33		11.67		9.85													
	En-th	8.73 E+08		1.40 E+09		5.43 E+08		8.73 E+08		6.79 E+08		1.09 E+09		6.11 E+08		5.61E+08		1.48 E+09		9.20 E+08		1.15 E+09		8.00 E+08		6.92 E+08		9.69 E+08		4.31 E+08		6.03 E+08		5.38 E+08		7.53 E+08		5.00 E+08		7.95 E+08		8.88 E+08		8.88 E+08		5.52 E+08		5.52 E+08		6.91 E+08		5.83 E+08													
	Str22	Arch 1	26.7		28.5		18.0		19.4		21.9		23.5		32.4		22.5		26.9		26.1		26.9		17.5		18.1		21.3		22.0		28.1		19.1		23.1																												
		Arch 2	23.8		25.2		15.7		16.8		19.3		20.5		28.6		19.5		23.5		23.4		24.0		15.4		15.9		19.0		19.5		25.1		16.7		20.4																												
		Arch 3	19.6		20.3		12.3		12.9		15.5		16.2		23.2		15.2		18.8		19.6		20.0		12.4		12.6		15.6		15.9		20.9		13.3		16.7																												
	Str26	Arch 1	23.8		NaN		15.7		NaN		19.3		NaN		NaN		NaN		NaN		23.9		25.2		15.8		16.9		19.4		20.6		25.2		16.8		20.5																												
Arch 2		20.9		NaN		13.4		NaN		16.7		NaN		NaN		NaN		NaN		21.3		22.1		13.7		14.4		17.1		17.8		22.3		14.5		17.9																													
Arch 3		16.7		NaN		10.1		NaN		13.0		NaN		NaN		NaN		NaN		17.5		17.7		10.7		10.8		13.7		13.9		18.1		11.1		14.2																													
12	Annual km	105000								988682		988682		105000								807136				105000								880986																															
	Years	15		15		6.67		6.67		8.33		8.33		9.42		9.42		15		15		6.67		6.67		8.33		8.33		7.69		15		15		6.67		6.67		8.33		8.39																							
	En-th	1.49 E+09		2.02 E+09		6.61 E+08		8.96 E+08		8.26 E+08		1.12 E+09		9.33 E+08		9.14 E+08		1.88 E+09		1.88 E+09		8.37 E+08		8.37 E+08		1.05 E+09		1.05 E+09		9.65 E+08		1.62 E+09		1.62 E+09		7.21 E+08		7.21 E+08		9.02 E+08		9.0 8E+08																							
	str21/22	Arch 1	29.0		29.4		14.6		14.9		18.0		18.3		33.6		17.7		21.4		31.6		27.6		16.3		23.1																																						
		Arch 2	25.2		25.5		12.0		12.2		15.1		15.3		29.4		14.8		18.2		27.6		13.6		20.4																																								
		Arch 3	19.8		19.9		8.3		8.4		11.0		11.1		23.3		10.7		13.6		22.0		9.8		16.7																																								
	str25/26	Arch 1	23.3		NaN		10.8		NaN		13.7		NaN		NaN		NaN		NaN		25.2		16.8		20.5																																								
Arch 2		19.6		NaN		8.2		NaN		10.9		NaN		NaN		NaN		NaN		22.3		14.5		17.9																																									
Arch 3		14.2		NaN		4.6		NaN		6.8		NaN		NaN		NaN		NaN		18.1		11.1		14.2																																									

Legend

- Capacity fade above and equal 30%
- Capacity fade above or equal to 20% and below 30%
- Capacity fade above or equal to 10% and below 20%
- Capacity fade below 10%

En capacity fade at several thresholds in years and km

Legend	
■	Capacity fade above and equal 30%
■	Capacity fade above or equal to 20% and below 30%
■	Capacity fade above or equal to 10% and below 20%
■	Capacity fade below 10%

HDV Vehicle group		Mission Profile																																							
		Construction ref								Long Haul ref								Municipal Utility ref								Regional Delivery ref								Urban Delivery ref							
		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1		15 y		700000 km		875000 km		EoL@20% capacity fade arch 1									
		w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO	w PTO	w/o PTO							
N3>16t	16	Annual km	60000						617753																																
		Years	15	15	11.67	11.67	14.58	14.58	10.30	9.58																															
		En-th	8.22E+08	1.35E+09	6.40E+08	1.05E+09	8.00E+08	1.32E+09	5.64E+08	5.25E+08																															
	str22	Arch 1	27.1	28.6	22.2	23.6	26.6	28.1																																	
		Arch 2	24.3	25.5	19.7	20.7	23.8	24.9																																	
		Arch 3	20.2	20.9	16.1	16.7	19.7	20.4																																	
	str26	Arch 1	NaN	NaN	NaN	NaN	NaN	NaN																																	
		Arch 2	NaN	NaN	NaN	NaN	NaN	NaN																																	
		Arch 3	NaN	NaN	NaN	NaN	NaN	NaN																																	

En capacity fade at given years and km for vehicle group and mission profiles

Vehicle group

Construction

Long Haul

Municipal Utility

Regional Delivery

Urban Delivery

3.5t < N2 < 12t

0

1

2

Construction

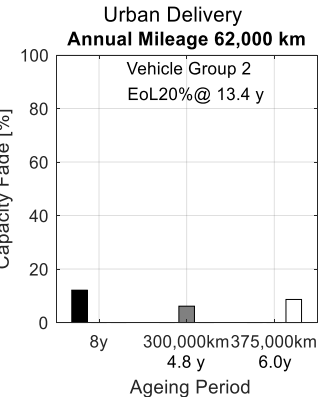
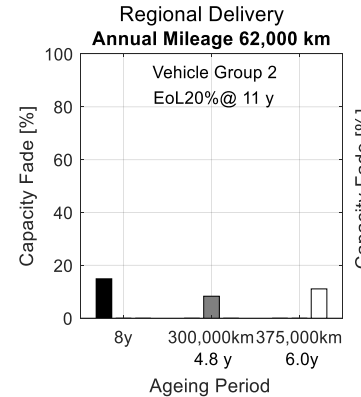
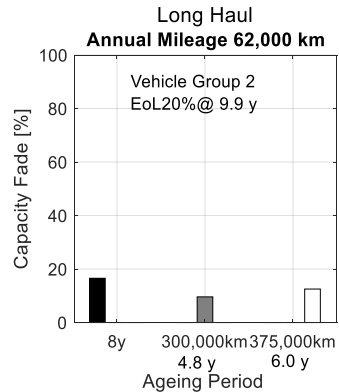
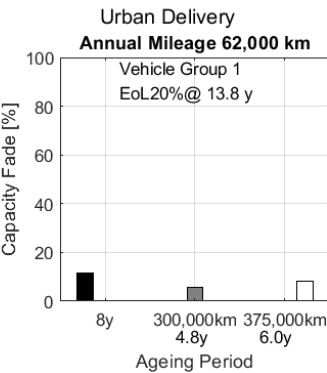
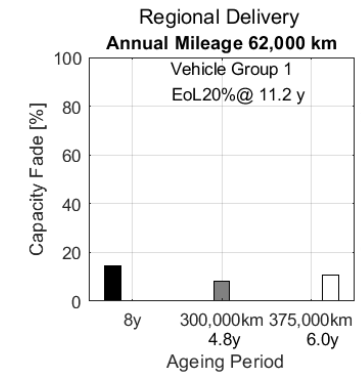
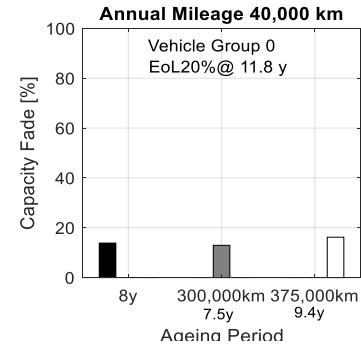
Long Haul

Municipal Utility

Construction

Long Haul

Municipal Utility



EVE-61-08e - UK warranty analysis
3.5t < N2 < 12t

- 70% 8y, 160,000 km
- 70% 5y, 100,000 km
- 80% 3y, in addition to 5y
- 70% 8y, 800,000 km

En capacity fade at given years and km for vehicle group and mission profiles

Vehicle group

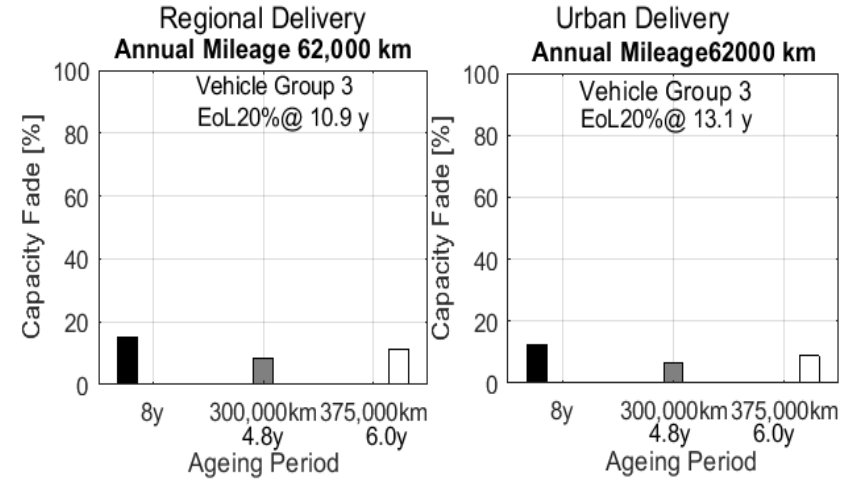
Construction

Long Haul

Municipal Utility

3

12t < N3 < 16t



- EVE-61-08e - UK warranty analysis N2 > 12t
- 80% 3y, 100,000 km
- 85% 5y, unlimited km (1 vehicle)
- 80% 3y, 70% 5y
- 80% 3y or 300,000km
- 80% 6y

En capacity fade at given years and km for vehicle group and mission profiles

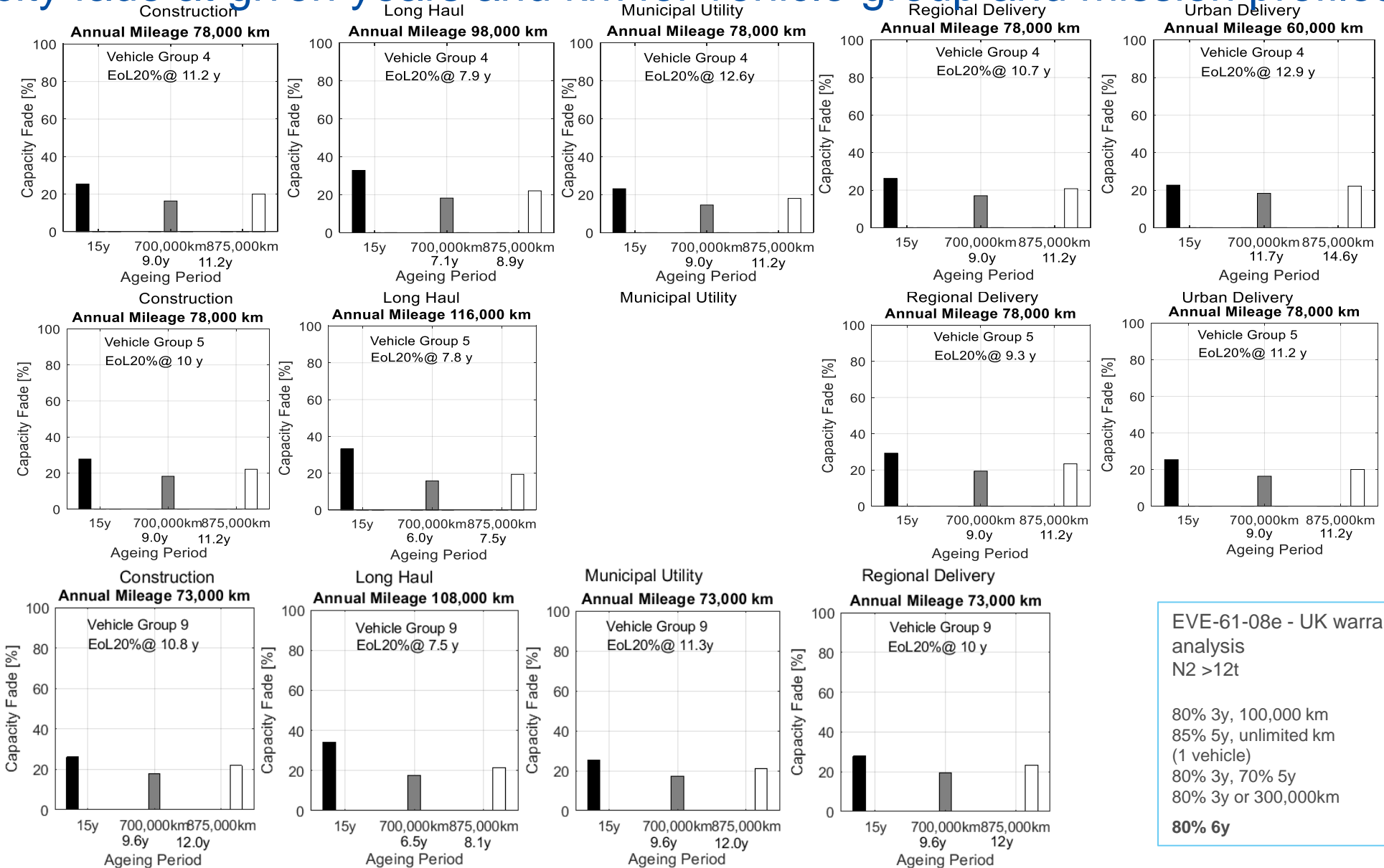
Vehicle group

N3>16t

4

5

9



EVE-61-08e - UK warranty analysis
N2 >12t

- 80% 3y, 100,000 km
- 85% 5y, unlimited km (1 vehicle)
- 80% 3y, 70% 5y
- 80% 3y or 300,000km

80% 6y

En capacity fade at given years and km for vehicle group and mission profiles

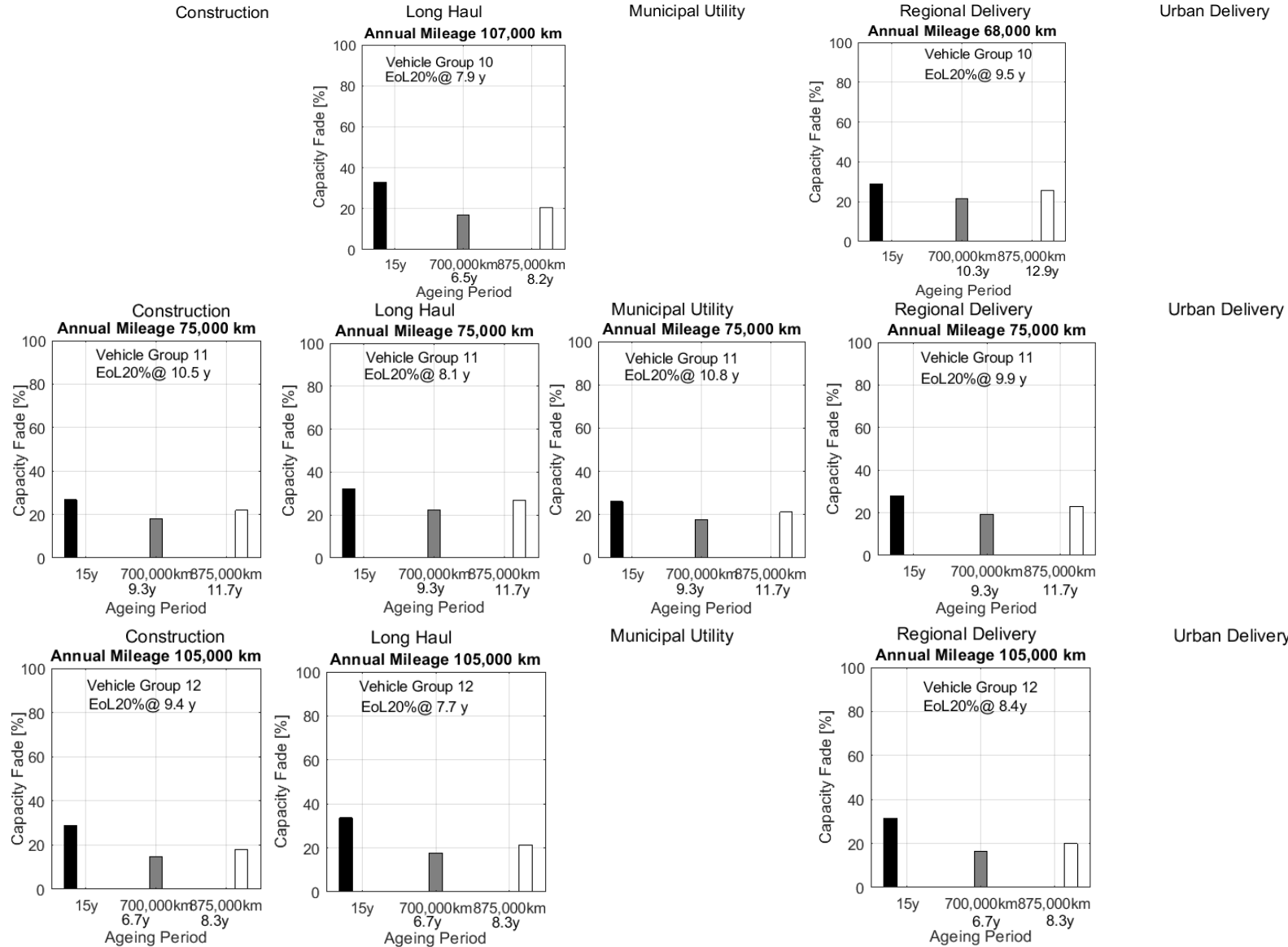
Vehicle group

N3>16t

10

11

12



EVE-61-08e - UK warranty analysis
N2 >12t

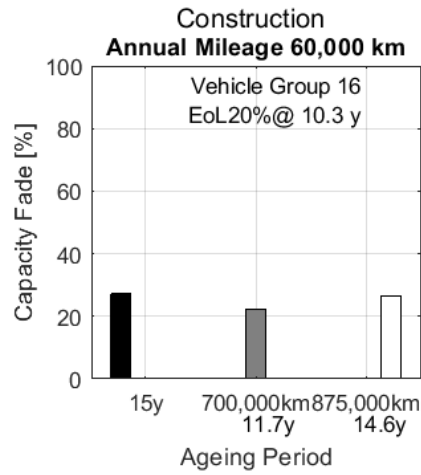
- 80% 3y, 100,000 km
- 85% 5y, unlimited km (1 vehicle)
- 80% 3y, 70% 5y
- 80% 3y or 300,000km

80% 6y

En capacity fade at given years and km for vehicle group and mission profiles

Vehicle group

16



Long Haul

Municipal Utility

Regional Delivery

Urban Delivery

EVE-61-08e - UK
 warranty analysis
 N2 >12t

80% 3y, 100,000 km
 85% 5y, unlimited km
 (1 vehicle)
 80% 3y, 70% 5y
 80% 3y or 300,000km

80% 6y

N3>16t

Str. 21 DC 1.2MW &
 Str. 22 DC 600kW
 Lunch break opp.

EVE IWG 68th, Web-meeting
 February 28th-29th 2024



En capacity fade at given years and km for vehicle group and mission profiles

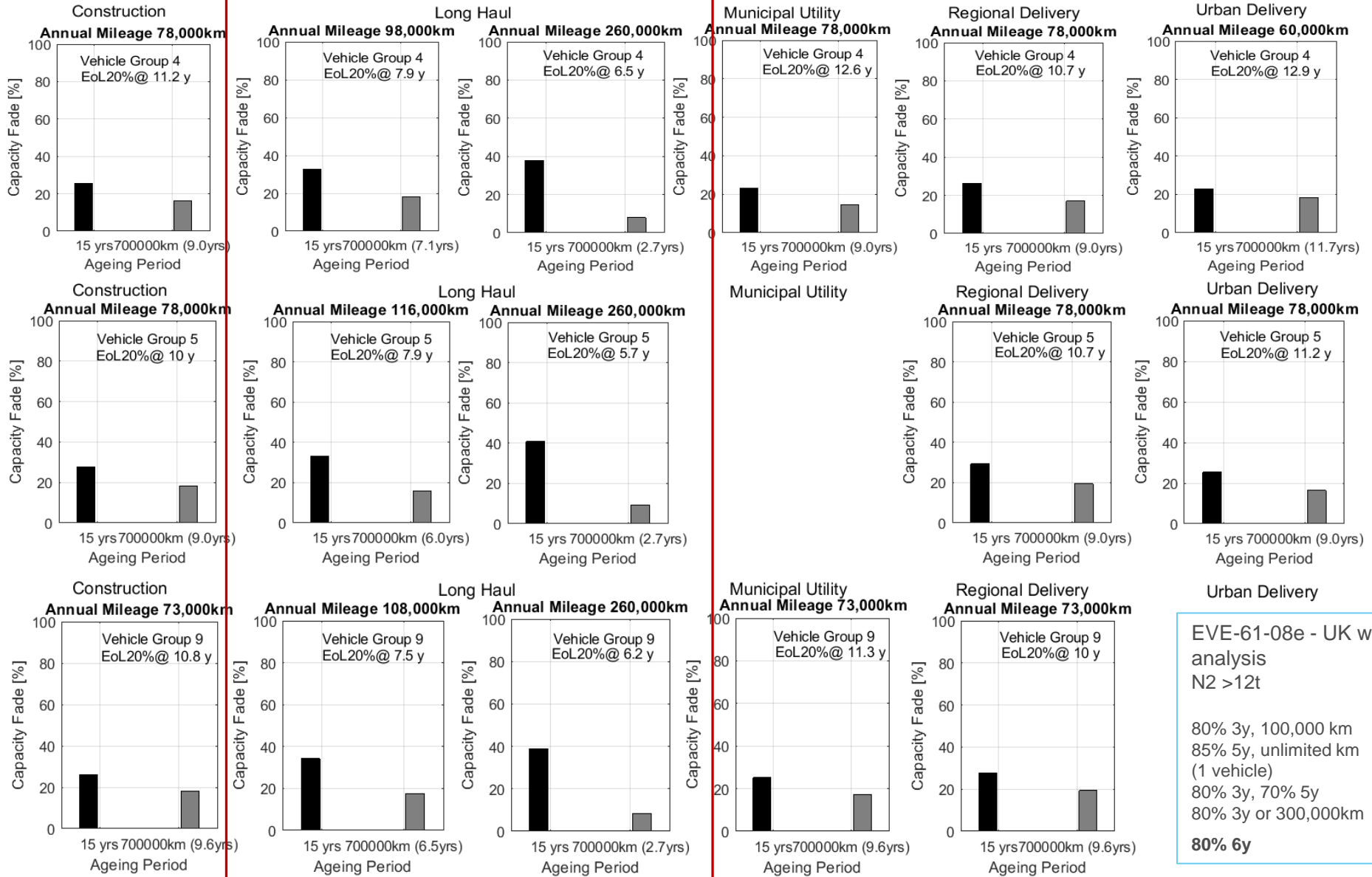
Vehicle group

4

5

9

N3>16t



EVE-61-08e - UK warranty analysis
N2 >12t

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EVE IWG 68th, Web-meeting

February 28th-29th 2024



Str. 21 DC 1.2MW &
Str. 22 DC 600kW
Lunch break
opportunistic

En capacity fade at given years and km for vehicle group and mission profiles

Vehicle group

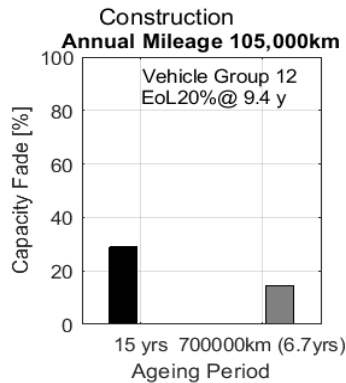
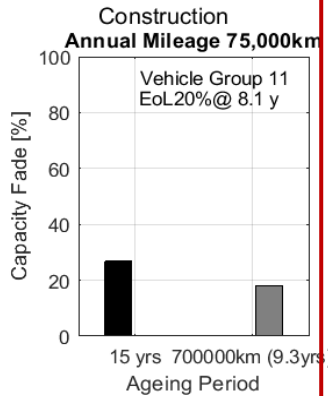
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11

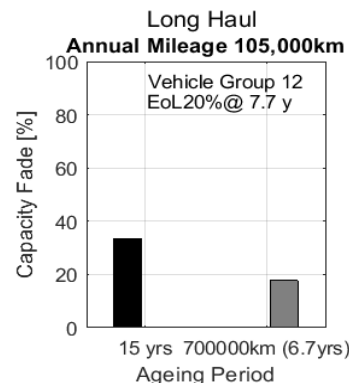
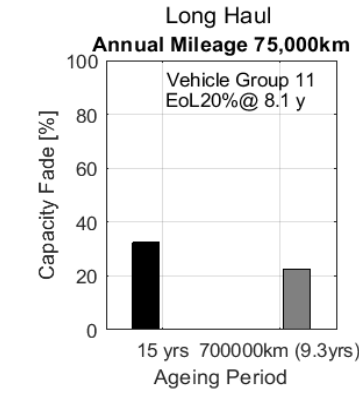
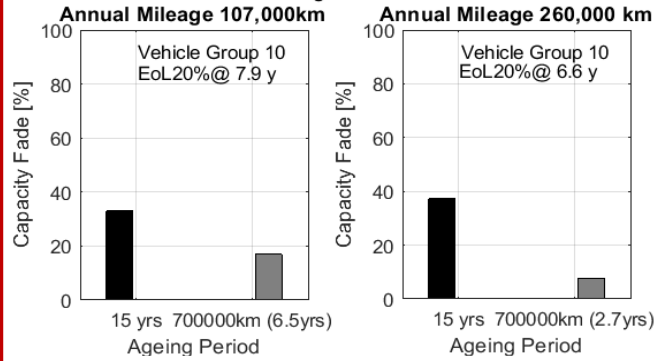
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N3>16t

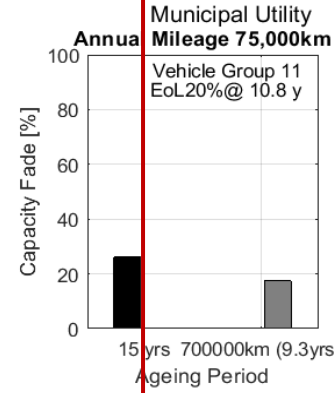
Construction



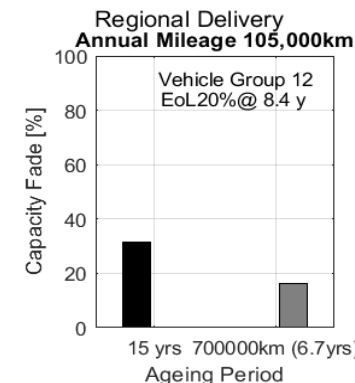
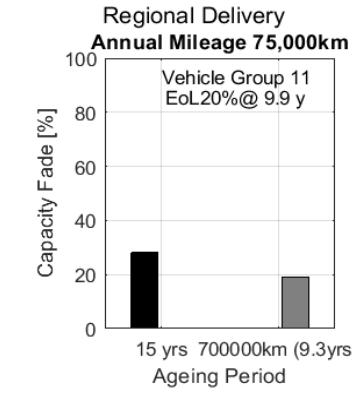
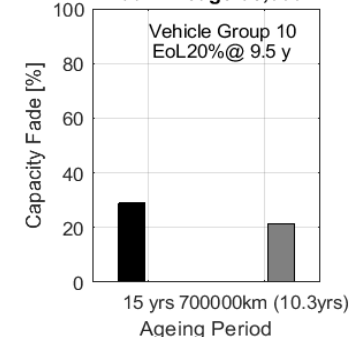
Long Haul



Municipal Utility



Regional Delivery



Urban Delivery

Urban Delivery

Urban Delivery

EVE-61-08e - UK warranty analysis
N2 >12t

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- 85% 5y, unlimited km (1 vehicle)
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EVE IWG 68th Web-meeting

February 28th-29th 2024



Str. 21 DC 1.2MW &
Str. 22 DC 600kW
Lunch break
opportunistic

Thank you

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